

Renovation Toolbox 2.0: Assessing the sustainability of adapted vernacular houses

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Appendix 1 : Photographic documentation of 55 Tibetan houses across 10 typologies

Typical

Traditional house - typical Tibetan house, rural freestanding



1.1



1.2



1.3



1.4



1.5

Mixed incorporation of glazing

Facade house - partial glazing incorporated at facade



1.6



1.7



1.8



1.9



1.10

Aggregate house - courtyard is partially enclosed by glass



1.11



1.12



1.13



1.14



1.15



1.16



1.17



1.18

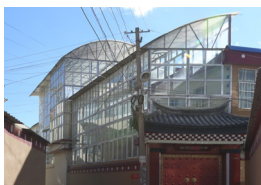


1.19



1.20

Multiple aggregate house - courtyard enclosed by a series of glass volumes



1.21



1.22



1.23



1.24



1.25

Double house - the traditional house is doubled by a fully glazed courtyard volume



1.26



1.27



1.28



1.29



1.30

Appendix 1 : Photographic documentation of 55 Tibetan houses across 10 typologies

New construction

Greenhouse - new-build concrete Tibetan house incorporating greenhouse



1.31



1.32



1.33



1.34



1.35

Concrete greenhouse - emergent new-build type, courtyard structure is extended up to support the greenhouse



1.36



1.37



1.38



1.39



1.40

Rowhouse - greenhouse spanning multiple building in new-build constructions



1.41



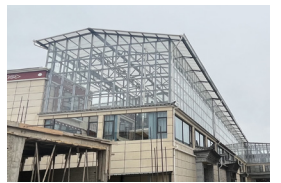
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1.43



1.44



1.45

Unique variations

Internal greenhouse - cases incorporating glazing within dense urban space



1.46



1.47



1.48



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1.50

Religious mixed use - unique case incorporating glazing for significant population subset



1.51



1.52



1.53



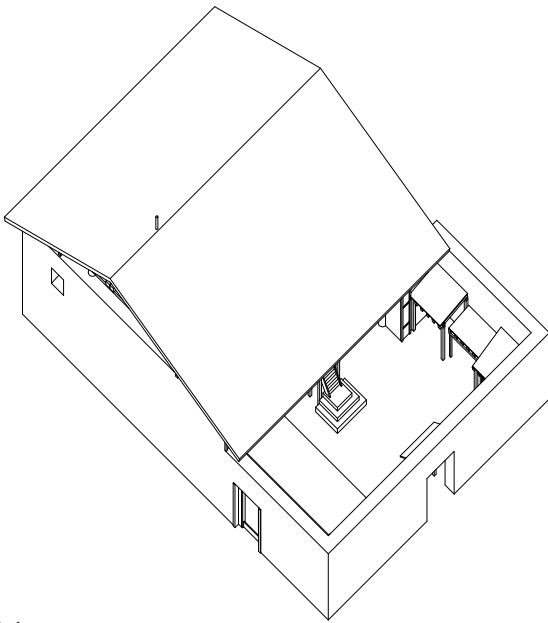
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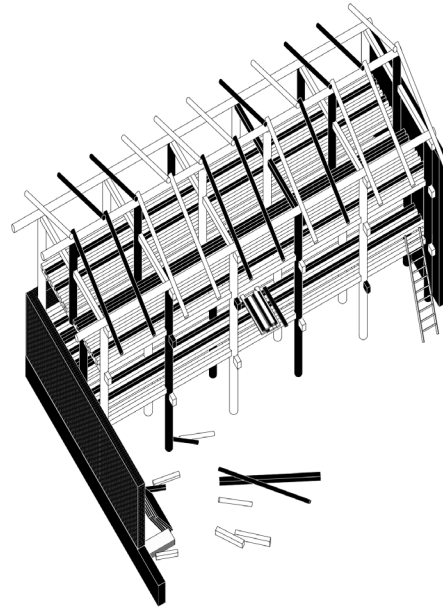
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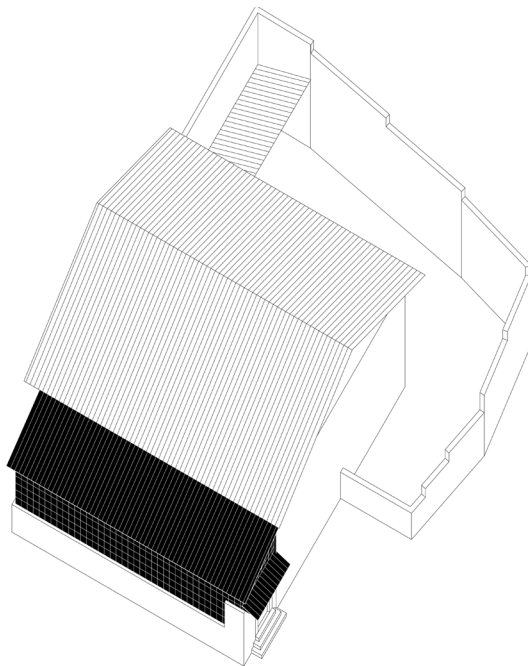
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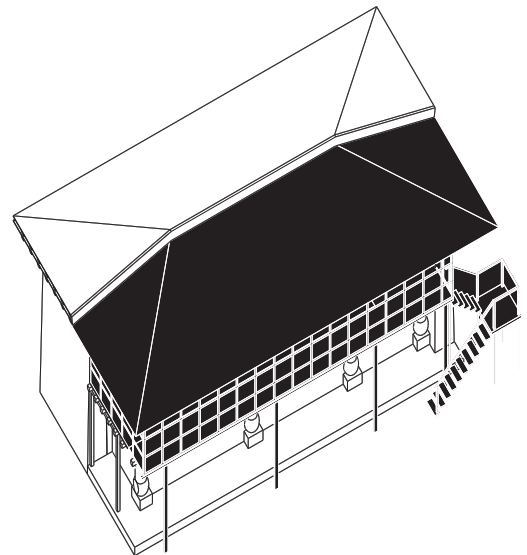
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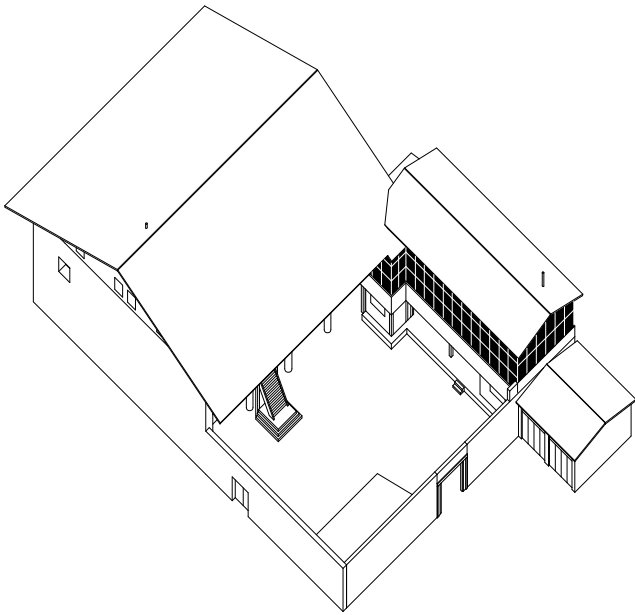


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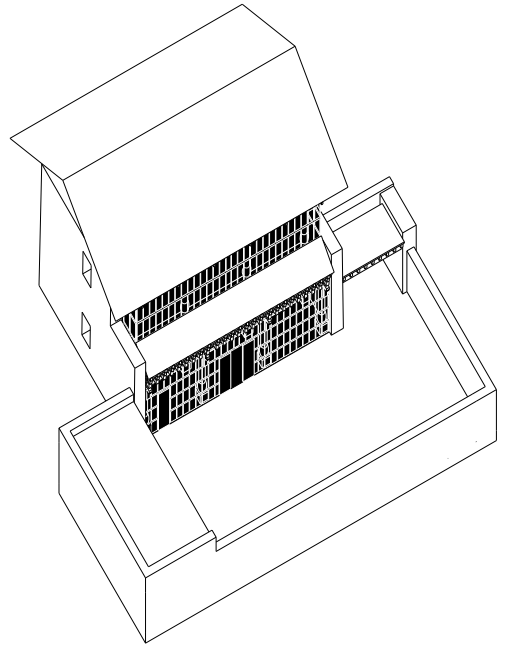


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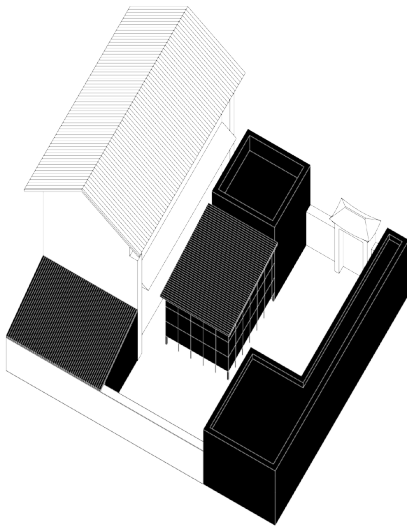
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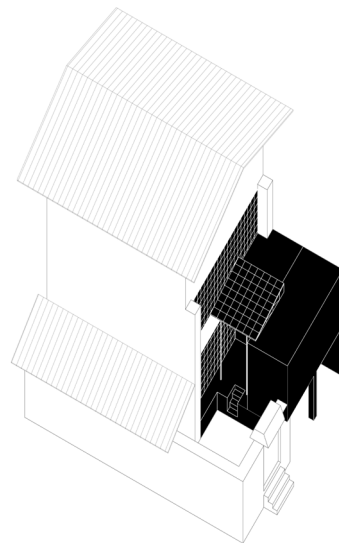
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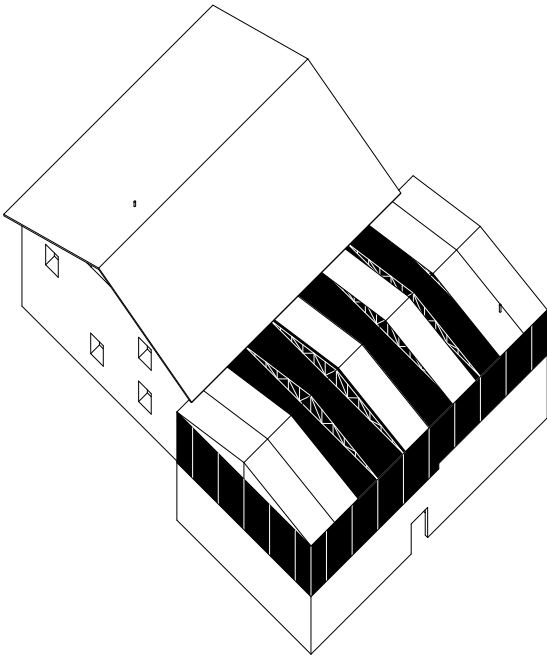


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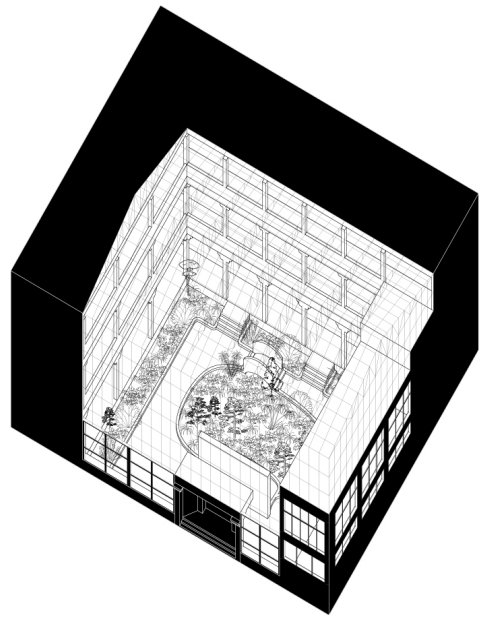


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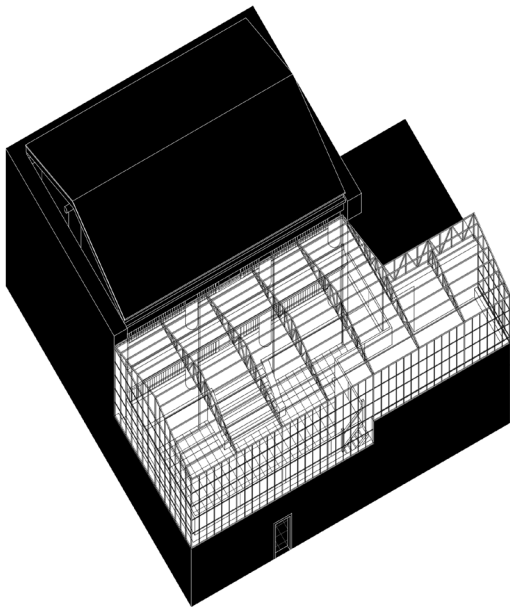
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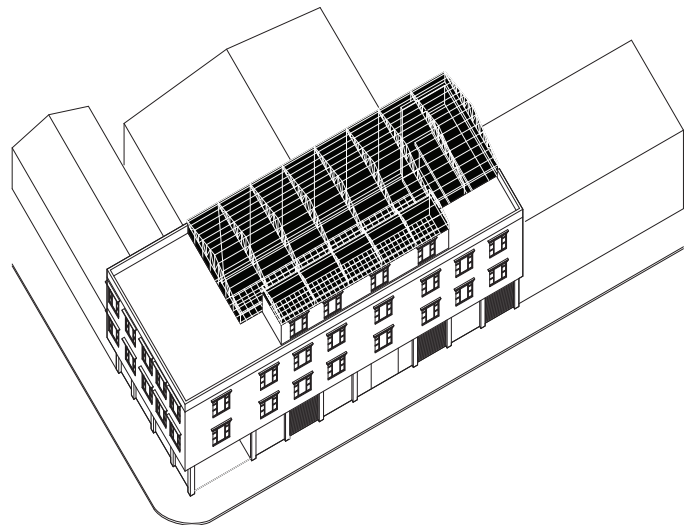
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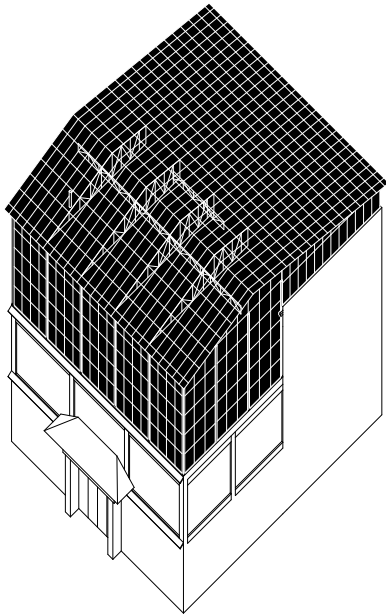


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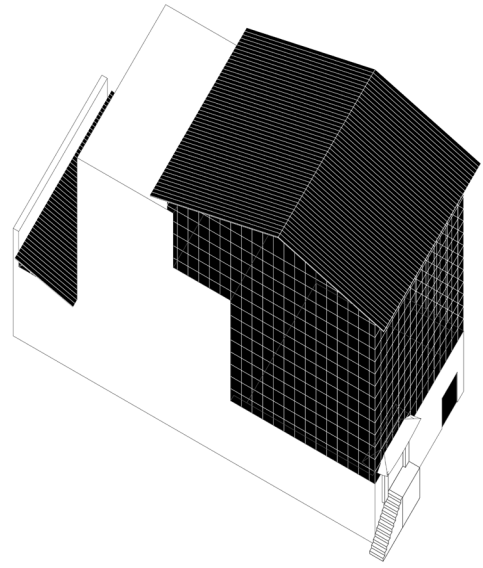


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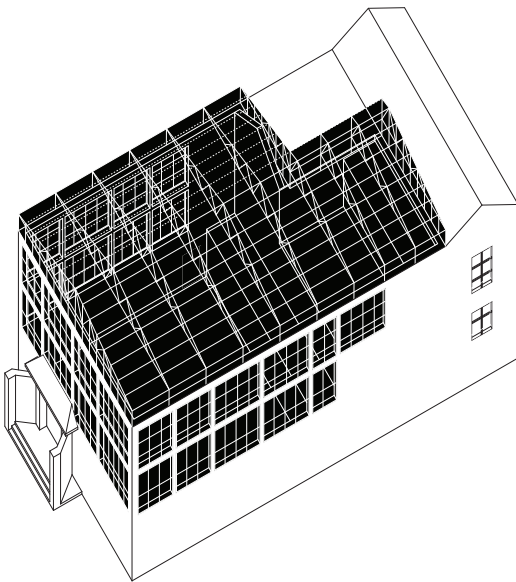
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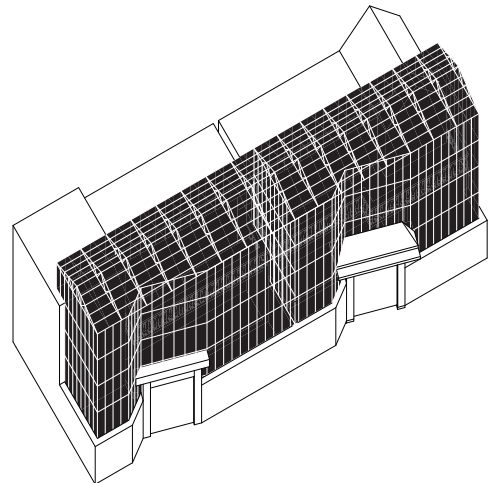
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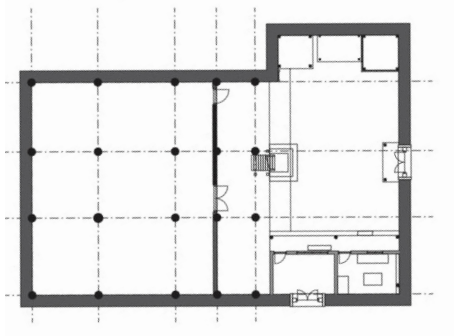
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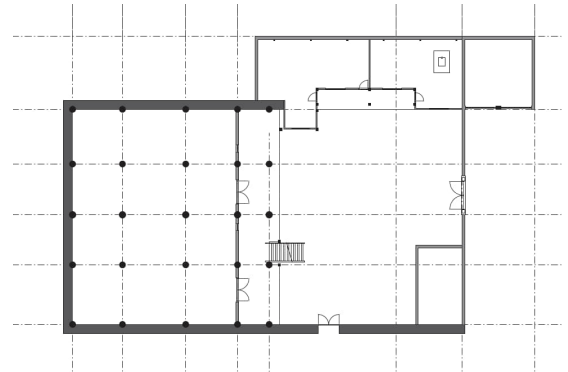
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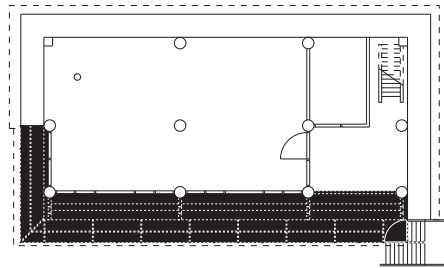
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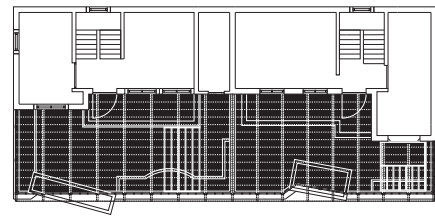
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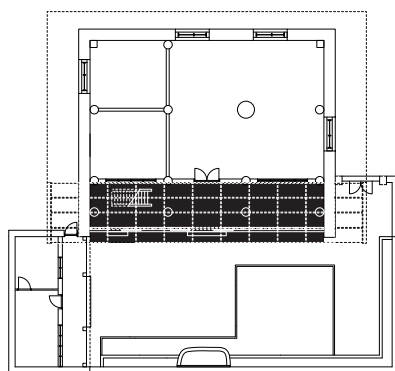
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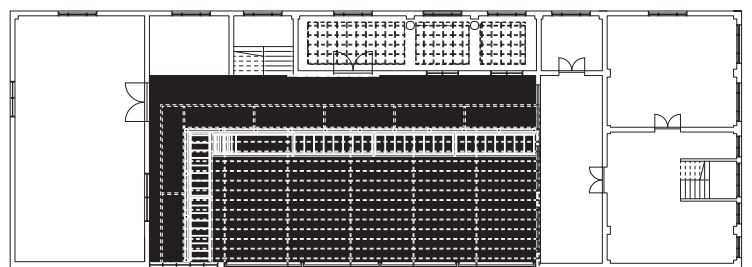
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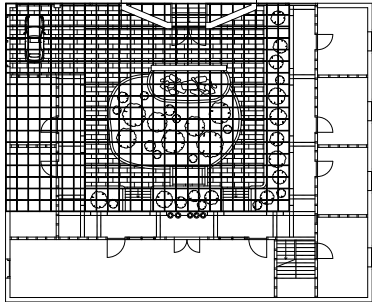
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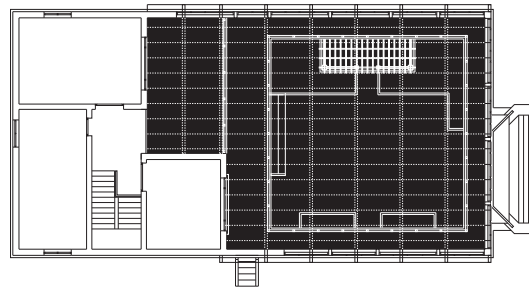
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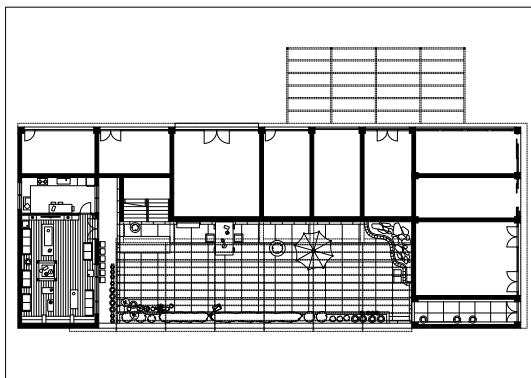
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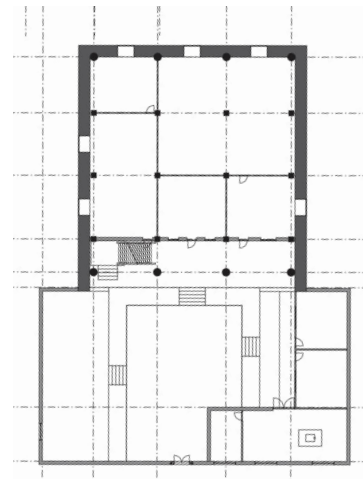
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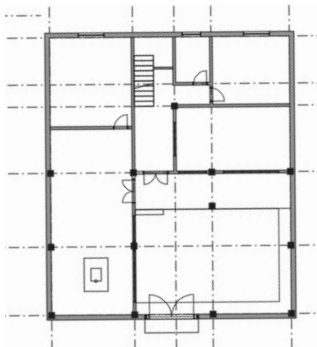
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Appendix 4

Interviews of selected households

4.1 Transparent House

Our village has many glass houses now. Winters here are very windy, so not many people stay during the cold months. In the past, our houses were built differently—the top floor stored animal feed, the middle floor was for living, and the ground floor kept our livestock. But now, we keep storage outside and use the house only for living, which is much more comfortable.

I renovated the third floor into a living space where guests can enjoy the view, especially in summer when the meadows bloom with Galsang flowers. It's beautiful, but I wouldn't let anyone sleep up there—it's too windy and unsafe, even though I sealed the roof.

This house took me nine years to build because getting materials was difficult. We couldn't source wood locally, so I had to buy it piece by piece from places like Myanmar, which was very expensive. Even unusable wood was included in the price, which made it harder.

In our culture, building houses is a deep tradition. Even if we inherit homes from our parents, we still build our own. My parents and grandparents passed theirs down to me, but I built mine anyway, and I expect my son will do the same. It doesn't always make financial sense—people here pour millions into their homes, whether they can afford it or not. But it's just what we do.

The most traditional Tibetan houses had rammed earth walls, but now we use concrete. Mud is too hard to find, and the government restricts digging. Concrete is cheaper and faster, even if it costs around 200,000 yuan just for the walls.

I changed my roof design from the old pitched style to a four-sided one for stability. Last winter, I finished the renovations, and now the view is stunning—in May, you can see Galsang flowers, lavender, and even the airport in the distance. Guests love sitting up here, though it's not for sleeping.

This is just how life is in Cuogu Village. We build, we adapt, and we keep our traditions alive, even when it's not easy.

4.2 Relocated house

We use this old house mostly in winter because our newer house, which has a flat roof, gets too cold. The old one is warmer, so we cook and gather here during the colder months. It's been around for a long time—I'm not sure exactly when it was built, but it was here before I married my husband. The new house was finished about seven years ago.

This house was actually moved down from the mountains. Originally, it had four big columns, but when we rebuilt it here, we only used three. We couldn't bring the mud walls, so we built new ones, and later we added the glass section for better insulation. At first, we didn't want the glass because it would hide the wooden columns, but after two years, we decided to add it because it makes the house much warmer. Now, six of us live here—my parents-in-law downstairs, and my husband, our two daughters, and I upstairs. We used to keep animals on the first floor, but the government doesn't allow that anymore, so we had to stop. If we want to keep livestock now, we'd have to build a separate barn.

We don't plan to tear this house down. It's useful, and I think it's beautiful. The government doesn't give us money to renovate it since we already have the new house, but if they ever decide to protect it as a traditional home, that could help with repairs and maybe even bring visitors.

The researchers said they want to include our house in a book about traditional houses, comparing it to homes in Guizhou and other places. I'm happy they find it interesting—it's different from most houses in the village, and I like that. For now, we'll keep it as it is unless we can afford to make improvements later.

When we built our home, we followed our Tibetan traditions carefully. The main house must face south, and the entrance should open west or south—never east or north. Even the interior doors are placed slightly offset from each other; aligning them directly would bring bad luck.

We added the glass section mainly for winter. It traps warmth when the cold winds blow, though nights still get chilly. In summer, it becomes too hot - we solve this by opening windows, using curtains, and applying special heat-blocking film on half the roof.

Our three floors each serve important purposes:

Downstairs is where we gather as a family, especially around the fire in winter

The middle floor holds our bedrooms

The top floor is our sacred space for prayer and meditation

The glass walkway around the house isn't just pretty—it makes cleaning easier and will soon hold flower beds. Every design choice, from the mixed roofing materials to the staggered doors, combines our traditions with practical modern living.

4.3 Brothers House

Our two houses weren't built at the same time—my older brother's came first, then mine. But the roof? That we built together later, connecting both homes under one structure. People always ask why we did it this way. The truth is simple: it makes the whole building stronger, saves space since we don't need a gap between separate houses, and most importantly—we're brothers. What's mine is his, and his is mine.

When visitors first see our shared roof, they're surprised. "Isn't it complicated?" they ask. But for us, it was practical. The wide-span structure covers both homes efficiently, and yes—it actually gives us more usable space than two separate roofs would. The glass section in the middle isn't sealed; it lets light filter through while still keeping the warmth in during winter. Some think we did it to save money, but the cost was the same—we pay by the square meter here, whether the structure is shared or not.

Our house might look European to some—with its clean lines and glass—but the government now insists that new buildings keep a Tibetan appearance. Not that it matters much for the glass parts; they only care about the window frames and doors having traditional designs. In summer, the glass makes the house unbearably hot, but in winter? Perfectly warm.

People from the university came to study our home, curious about why two families would share a roof. To us, it's natural. We're family—why build separate structures with empty space between them? My brother and I don't worry about boundaries. I even showed the researchers another house nearby, one that blends Han and Tibetan styles more deliberately. Ours wasn't built for style, though—just for practicality, and because when you're brothers, some things are better shared.

Years ago, nobody told us how to build. Now? The government wants everything to "look Tibetan" from the outside. Does it change how we live? Not really. The glass stays, the frames follow the rules, and the roof—our shared roof—keeps both our families sheltered, together.

4.4 Evolving House

This was the only house here at first—just the traditional wooden structure that we built ourselves as a family. But over time, we expanded, adding the new section with its glass facade. The original house was our own work, but for the modern addition, we hired construction workers from Sichuan province.

The glass structures actually have a long history here—people in our area started building them over forty years ago. I first saw one in Napahai and learned the technique from relatives there. While the glass portion cost about 50,000 yuan, it wasn't prohibitively expensive, and now this courtyard space has become usable year-round—a place where we gather in every season.

Our family of six spans three generations: my parents, grandparents, and two grandsons—one pursuing a master's degree in Kunming after studying in Beijing, the other working as a tour guide at a local scenic spot. We maintain 13 mu of farmland where we grow highland barley and tartary buckwheat, though we no longer keep animals.

While we're removing some unnecessary glass elements now, we have no immediate plans for further construction. The house has evolved gradually—from our original self-built wooden home to this blended structure that honors tradition while embracing useful modern elements. It's been a process of learning from others and adapting to our family's changing needs across generations.

4.5 New Build House

Our house has changed completely from what it used to be. We tore down the old, smaller structure and started fresh with a concrete foundation and a glass-enclosed storage room on top - what we used to call the “grass attic.” Before, this upper space was open to store animal feed, but the strong winds forced us to enclose it with glass. Now we barely use it for storage anymore.

This construction has been our family project since last year, but finishing it will take much longer - probably 4-5 years in total. Just gathering the materials took 3-4 years alone. We had to source timber from everywhere - mostly from Kunming, with some pieces even coming from as far as Burma. The costs are staggering: over 1 million yuan total, with just one of our central support columns costing more than 10,000 yuan.

While the foundation is modern concrete, we’ve kept true to Tibetan traditions above. There are four main columns - the most important being the “middle column” at the center that must never be replaced. The other columns can be changed, but this one stays forever. All the woodwork is handmade by carpenters we’ve hired from different regions - some from Kunming, others from Dali. They know some traditional motifs, but for special designs, we have to guide them.

Even as we build, life continues. We still farm highland barley and raise cattle, though we’ve moved the animals to the hills. In summer, we collect valuable matsutake mushrooms from our land. The house is primarily for our family (though we might consider renting space), and like most Tibetans, we pour our savings into our home - it’s our custom. If we run out of money? We’ll just work harder to earn more for construction.

Our story isn’t unique - everywhere in the village, people are rebuilding. Some update old structures, others like us start fresh. The government now requires Tibetan-style exteriors, but inside we blend tradition with modern comforts. It’s a slow process, but when finished, this house will shelter generations to come - its central column standing strong as a testament to our heritage.

4.6 Multiple Aggregate House

Our roof has two different shapes - the main glass section must be flat—that’s just how it works best. The other part is arched in the traditional way. We use the flat glass roof cleverly—in spring, we’ll plant vegetables up there! The house gets very warm in summer, but in winter we light fires downstairs to stay cozy.

Our family of seven lives here—parents, children and grandchildren all together. Some rooms are for living, others are sacred spaces (we call them Jingtang) for our religious practices.

We kept part of the glass roof uncovered on purpose. It lets in light for our plants and creates a bright space. Even with these modern touches, we’ve kept true to what makes a Tibetan home—warm in winter, connected to the land, and full of family.

Both homes show how we Tibetans blend the old ways with new ideas—always keeping our traditions at heart while making practical improvements for daily life.

4.7 Double Glass House

This house of ours—it wasn't always like this. We used to have an open courtyard, but little by little, our neighbors built up their homes around us, blocking the sunlight. Now, even on bright days, the light doesn't reach us like it used to. We've been meaning to renovate the back section with glass, but winter makes construction impossible. The workers won't come until after the new year. My mother keeps saying we should expand—prepare a space for a mourning hall, just in case. I don't like talking about it. It makes me uneasy, thinking of such things. But I know we'll have to do it eventually.

For us Tibetans, a house isn't just shelter—it's a legacy. We'll eat the simplest meals, wear the same clothes for years, but pour everything into building a home worthy of our family. Some people rebuild every decade just to keep up with the latest style, even if it means spending millions. I don't always agree with it—it seems wasteful—but that's how it's always been. My parents built this house, and now it's mine to care for. My brothers and I pooled what we had to make it what it is today.

After my eldest brother died, things became harder. His widow remarried—a man my niece can't stand. She asks me why her mother chose someone so much older, so different from her father. What can I say? Life doesn't always make sense. I never married myself. The men here... well, they expect to be in charge, and I've never been one to follow orders. Besides, who would look after my mother if I left?

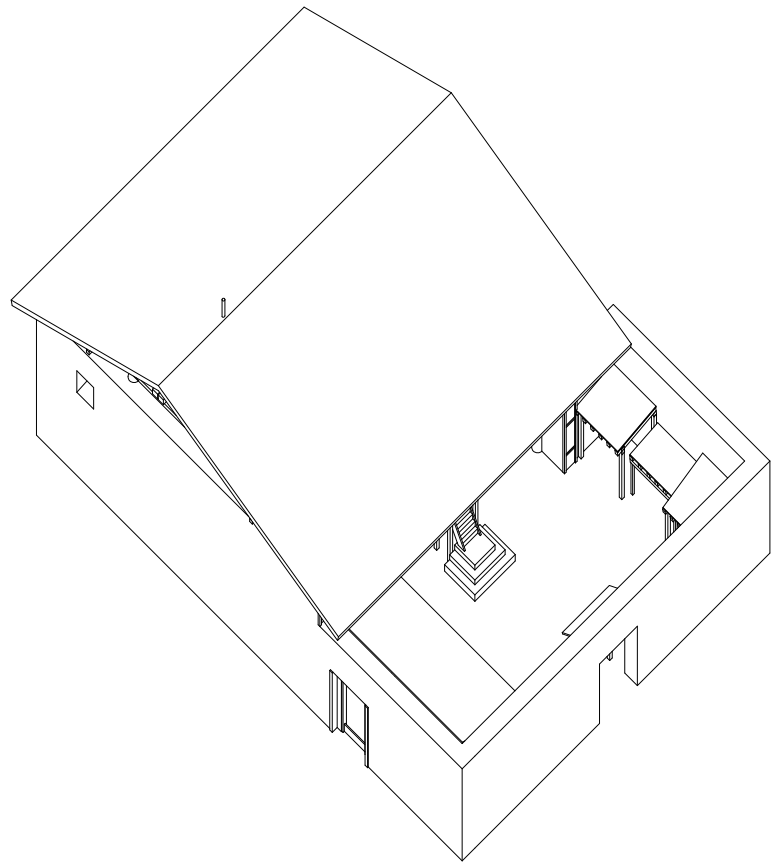
My niece—my late brother's daughter—is studying in Kunming now. She speaks perfect Mandarin, even some English, but rarely Tibetan. She wants to be a civil servant. I'm proud of her, but sometimes I wonder what she'll keep of our traditions.

Building this house wasn't easy. We had to buy wood all the way from Myanmar—good timber is hard to find, and the government doesn't allow logging here anymore. The glass sections? Contractors from Kunming did that work. We used a special material—FRB, a mix of glass and plastic—because regular glass wouldn't hold up against the wind and cold. Downstairs is where we live, cook, gather. Upstairs, we store barley and rapeseed oil, though we don't farm much anymore. My brothers are busy with work in town, and I never learned to drive the tractor.

Living here has its struggles. A few years ago, I slipped while picking mushrooms in the mountains and broke my leg. The local doctor said it would heal in five months, but even after seven, I could barely walk. In a village, if you can't work, you can't eat. People talk, too—everyone knows your business. But there's beauty here as well. In summer, the meadows bloom with Galsang flowers, and from the upper floor, you can see all the way to the airport.

Some traditions I keep close—like caring for my mother. I'll never understand Han Chinese families where children move away and leave their parents behind. But other customs? Like rebuilding houses just for pride? Maybe it's time to let go. Still, this house is more than wood and glass. It holds our history, our losses, our hopes. It's not perfect, but it's ours.

And for now, that's enough.



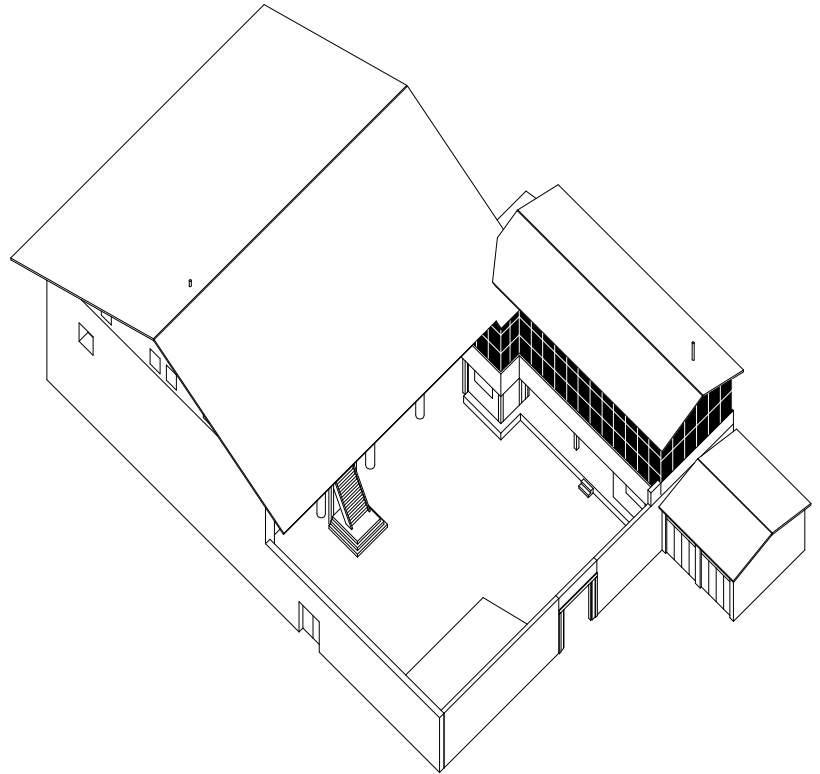
1 The Traditional House

The Traditional House is home to Chilipizu, his wife, teenage son and daughter. The family tends to agricultural as well as carpentry odd jobs. The Traditional House has three bays separated by wooden columns, spaced at irregular distances apart of 4.5, 4.3, and 5 meters, measured by the carpenter's body. The ground level houses a barn for draft animals. On the upper level, the largest space is the fire room at the rear north side of the house, at the elevated and "purest" location in the Tibetan cosmology of the house. It is the space for all social, ritual, and dining activity, centered around a thick tree trunk wooden column. There is a separate shrine room, and smaller bays contain bedrooms and store rooms.

Like many other Tibetan houses in the region, recently the family built a small extension in the courtyard, to house a new smaller fire room. The new location provides ease of access, and requires less fuel to heat. However, it becomes disconnected from its original ritualistic position, lowered to the secular and worldly ground level. The shrine room of the house was repurposed as a room for the children. They reside at school during the week, and return on the weekends. The room still bears the faded paint of colorful religious markings.

Though the Traditional House houses a nuclear family, Its occupation fluctuates. The main fire room is used for special occasions, unoccupied on a daily basis, but can provide for 30-50 guests during ceremonies, with space for dancing around the central ritualistic pillar. Extra bedrooms also become activated as guests pass through on seasonal and festival pilgrimages.

In Shangri-la, standards of living and hygiene have been raised due to government efforts. Chilipizu no longer has to travel kilometers to wells to bring back potable water. The house has indoor water taps, but there is still no bathroom. Bathing and lavatory activities take place in the nearby fields and hot springs. The house begins to incorporate modern materials, plumbing, and spatial organization, but continues to respond to vernacular living patterns - its boundaries remain permeable. The house is not defined by the sheltered interior space, but is activated by the seasonal rhythms of occupation and usage, and is programmatically spread out into the surrounding natural environment and wider region.

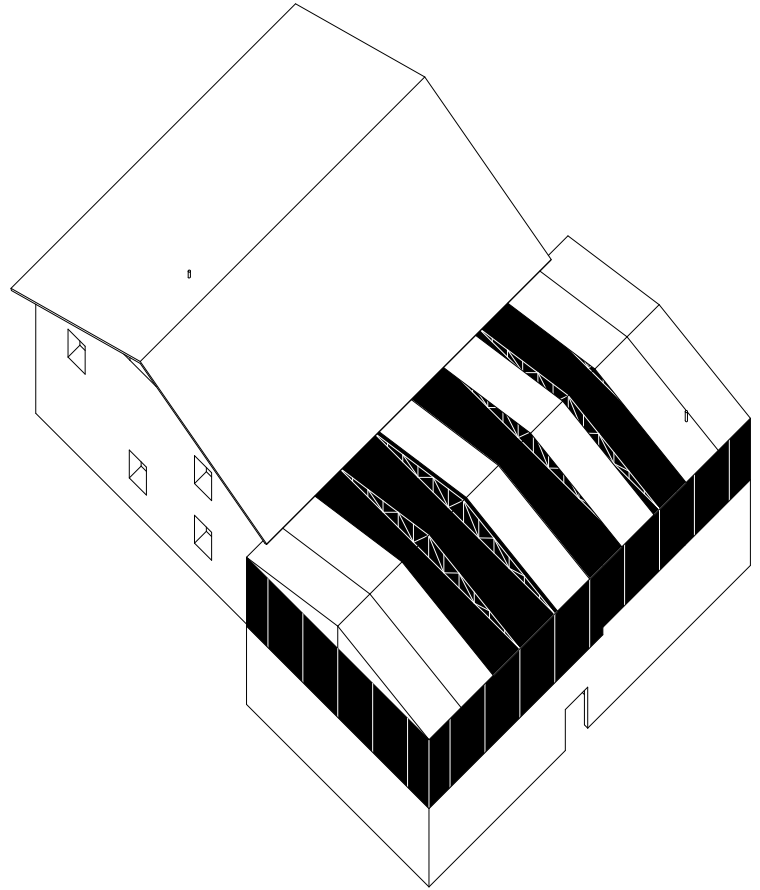


2 The Facade House

Tongshi is the eldest daughter, and will be the future owner of the Facade House. This house accommodates her parents, uncle, a great-uncle, and her future family. The fluctuating family structure is exemplified by the migration of the great-uncle, who has recently retired as a monk at Songzanlin. After a religious career, he does not own a house, nor have children to provide for him, but is welcomed as an honorable guest at the homes of his extended family.

The family began to experiment with glazing parts of the house, beginning with the upper level facade of the house. After they built a concrete extension and new ground level fire room, they also enclosed the space above it to create a new greenhouse room. The new fire room and stove requires a long pipe to channel smoke. This pipe protrudes through the greenhouse space, yet also noticeably provides a secondary source of heat. The area around this pipe is sectioned off, and becomes a new bedroom for the grandfather directly above the new fire room.

Whereas in a traditional house, permeable construction allows for heat to rise - in the new concrete and glass compartmentalized spaces, the family experiments with new ways to modulate temperature and airflow. With the glazing, the family enables new ways to capture warmth, but then experiments with new ways to modulate and block excessive heat using fabric curtains and modifying windows to be operable. The modern steel and glass structures are effective at creating new comfort zones, but the family quickly adapts the modern systems to recover and integrate the vernacular construction values of permeable and flexible building systems.



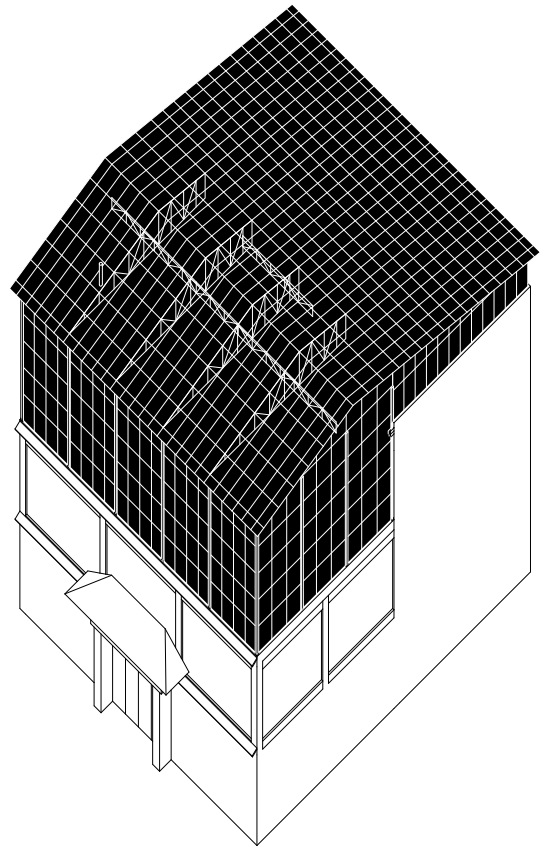
3 The Double House

At the Double House, the entire courtyard is encased in a glass greenhouse and joined to the original wooden house facade, in effect doubling the enclosed volume of the house.

In this house, the kitchen emerges as a new typology in the Tibetan house as separate from the fire room. In the traditional fire room, cooking, dining, socializing, and religious rituals were integrated in the fire room. In the transition from traditional to modern modes of living, we find this tendency to compartmentalize programmatic functions.

Despite the efficiencies of compartmentalized new programs, our analysis of the material culture and habits reveal that the usage of spaces spills out beyond individual rooms. For example, cooking a meal can take place on the stove in the fire room, but the interrelated processes of cooking still takes place throughout the house: the courtyard is used to wash dishes, butchery takes place outside of the main house, meats are dried hanging near various windows at the back of the house. The traditional meals of tsampa and butter tea, cooking and processing yak meat and milk, and dining habits have persisted, despite the incorporation of modern conveniences.

Though modern distinct programs and typologies begin to become common, the inhabitants' patterns of occupancy still exceed and permeate through the compartmentalized walls, and require a flexibility of usage. This vernacular way of occupancy is integrated with modern spatial organization.



4 The Rowhouse

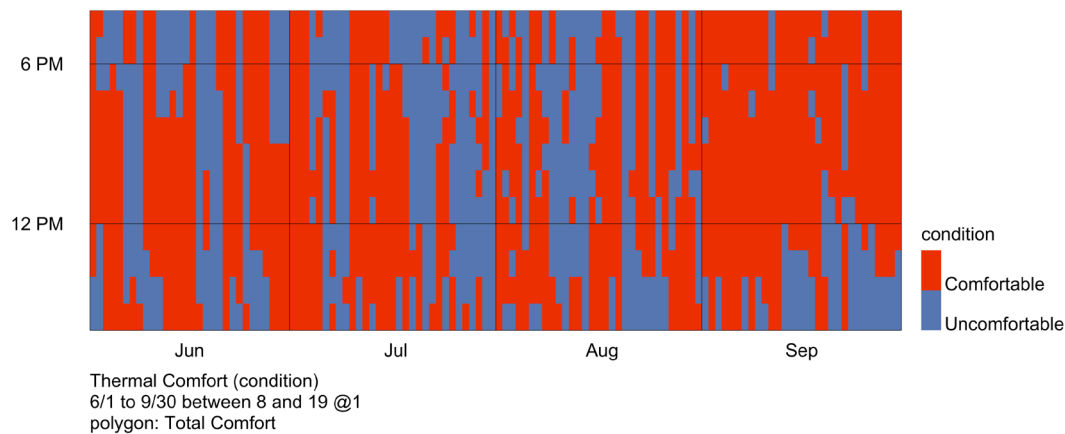
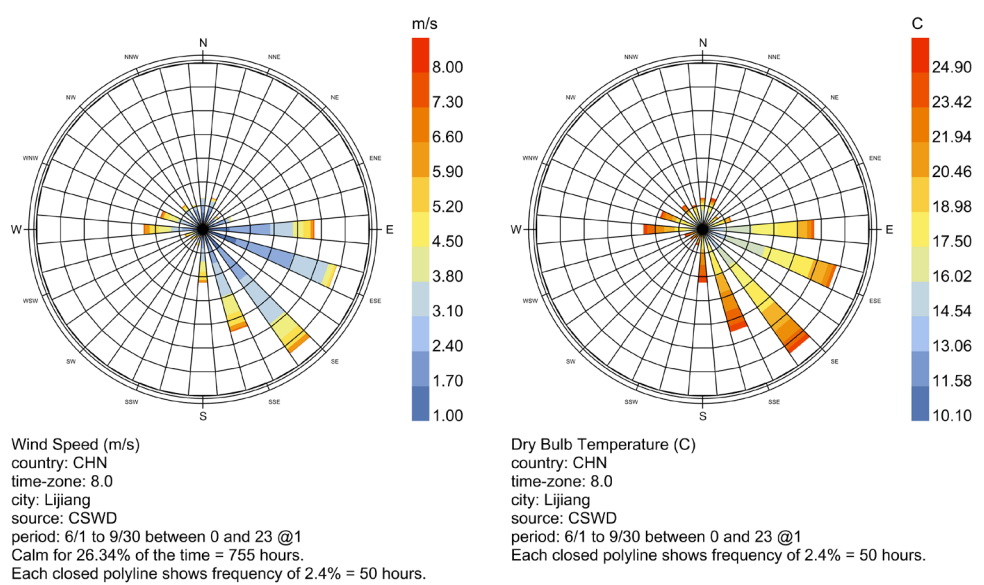
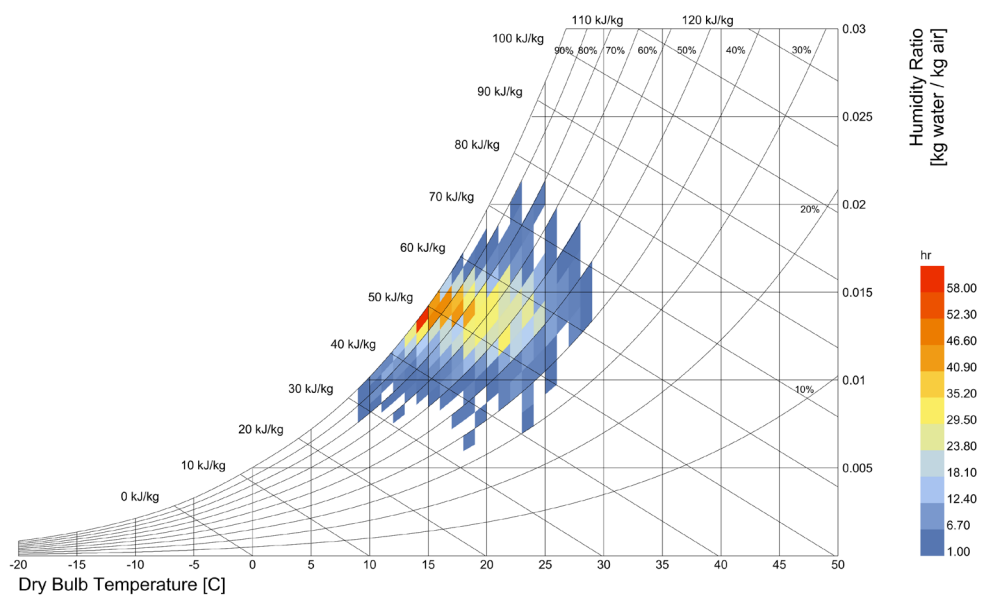
As Shangi-la develops industrially, new suburban developments emerge at the town perimeter. A row of concrete frame foundations and greenhouse volumes are built en masse, then can be individually modified to suit each owner. The Rowhouse replaces the traditional wooden pillars and earth walls with the concrete frame, retaining the traditional 3 bays but with a consistent bay width of 4.25 meters. Like the builder of the Traditional House who measures the irregular bays with his body, Biaoge designed this house based on his memory.

This Rowhouse is home to Biaodi, a businessman who works in the town, his wife, a toddler son, and his grandparents. There are additional rooms to accommodate lamas who visit once a year to read scripture, and rooms for nieces and nephews who may study nearby periodically. Biaodi's house is not only a house for a nuclear family, but a stepping stone for his extended family and village. The house is ready to accommodate fluctuating inhabitants, part of a network that connects his ancestral village 200 kilometers away, with the modernizing Shangri, and a stepping stone to further growth.

The new house construction is much more compact, but spread out on more levels. The courtyard now only occupies a corner of the ground level, but the upper level roofs have become occupiable spaces and take on the previous functions of the courtyard - drying laundry, bathing, socializing, and leisure.

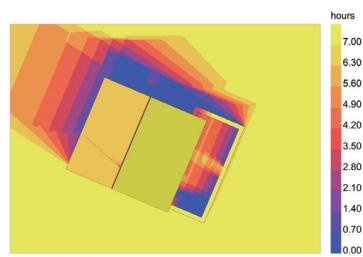
The large collective fire room has been subsumed into new ground floor fire room, which becomes even more prominent and opulent. Previously, painted and colored fabric were common materials to commemorate religious motifs. Now, Biaodi emphasizes the importance of durable walnut and hardwoods to carve religious stories for a diasporic Tibetan family.

Appendix 6
Site Environmental Analysis

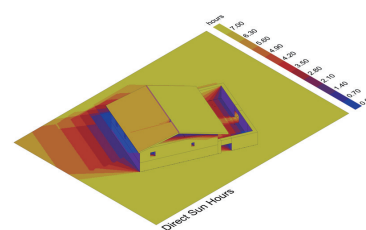
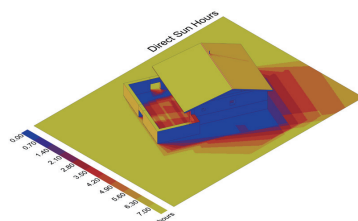


Case studies: Solar Analysis

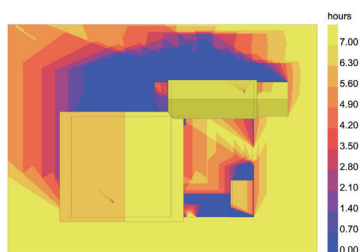
Direct sun hours during fall equinox 2023



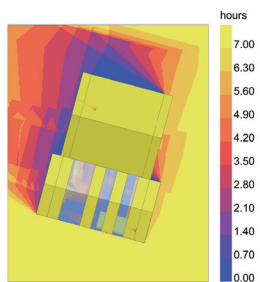
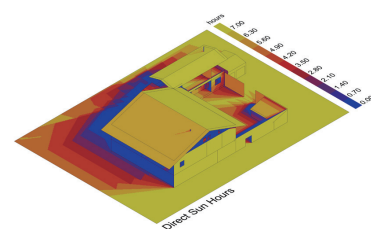
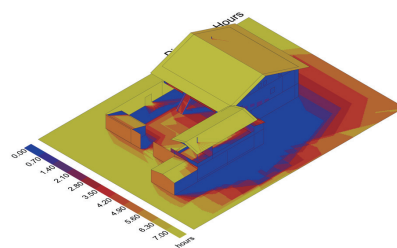
Direct Sun Hours



Hosue 1 ^

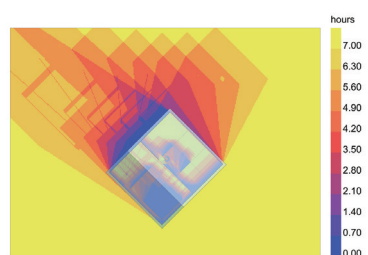
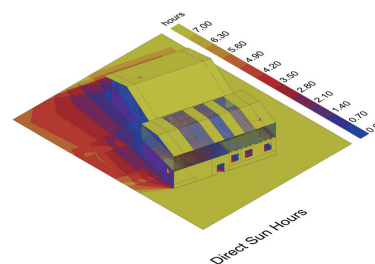
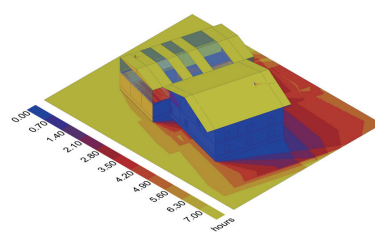


Direct Sun Hours

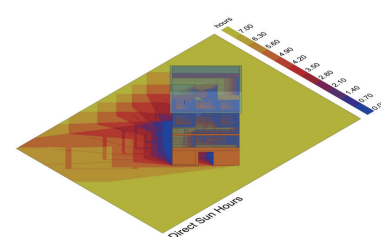
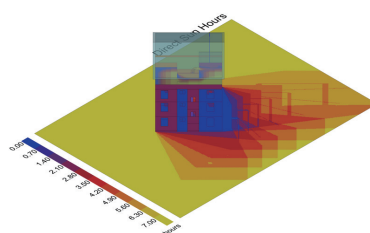


Direct Sun Hours

Hosue 3 ^

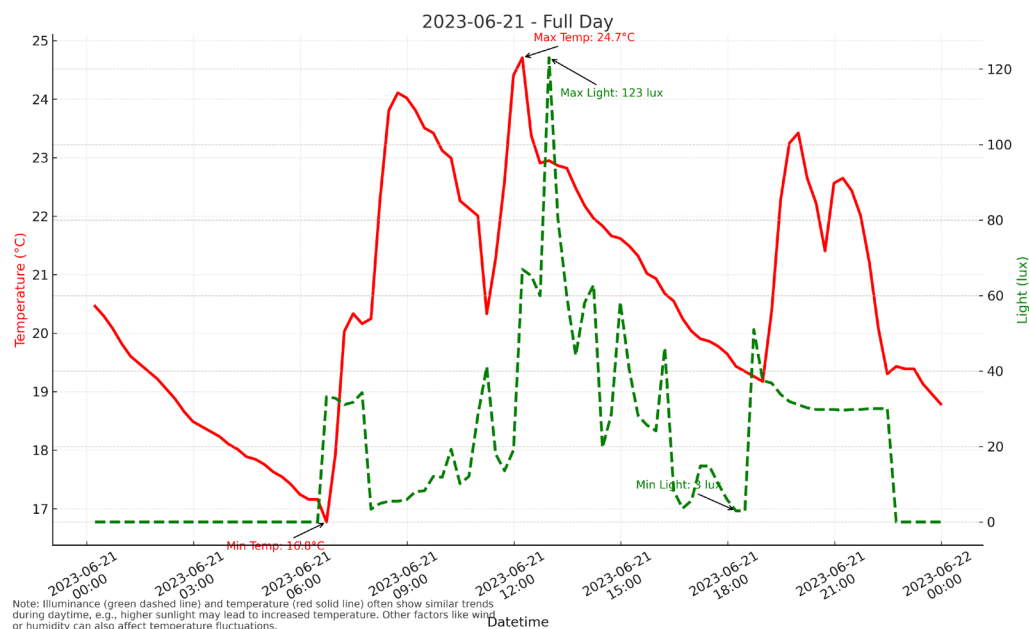
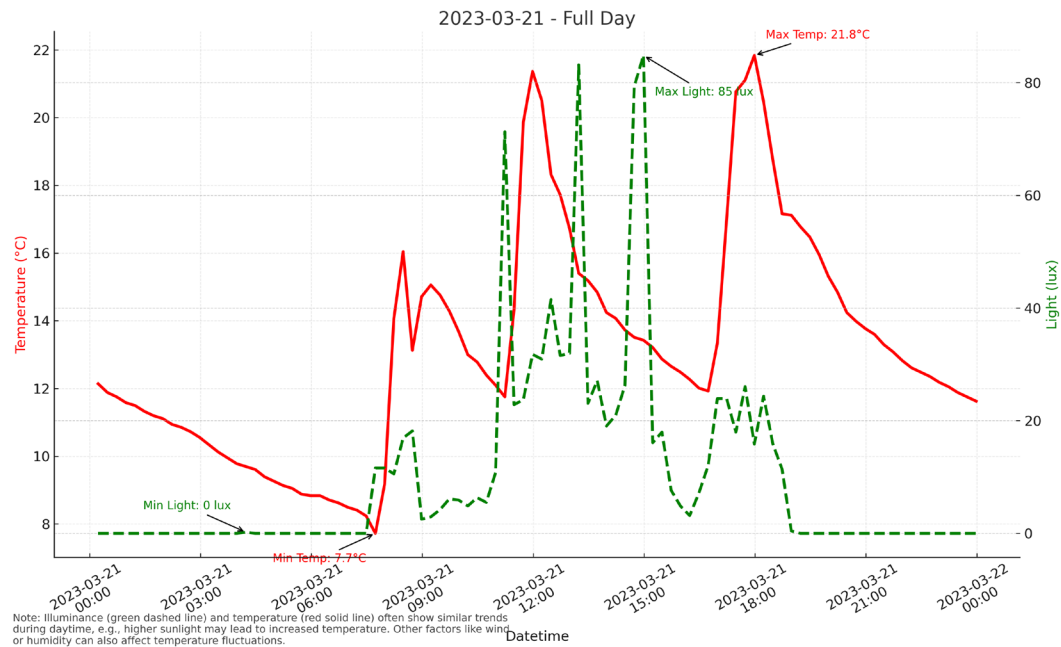


Direct Sun Hours



Appendix 8

Case studies: Temperature and Light logged March 21 - June 21, 2023



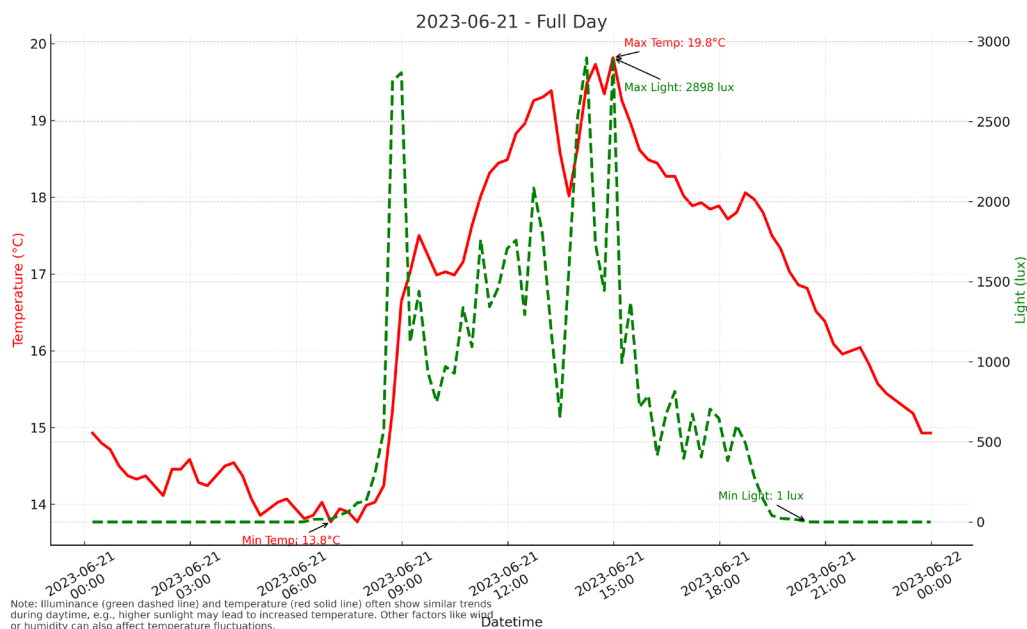
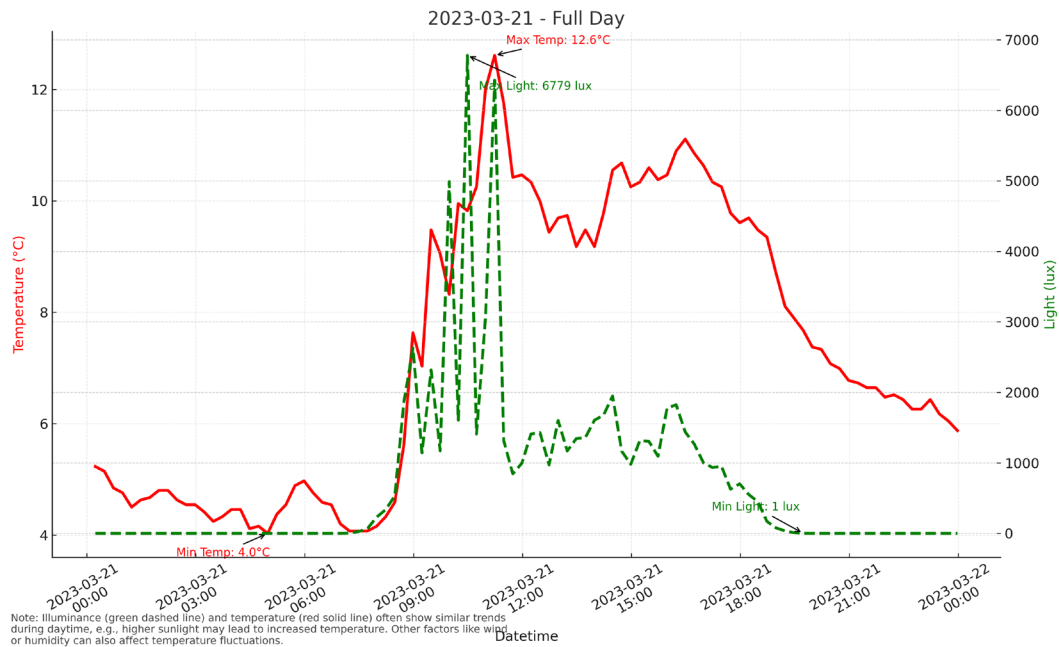
8.1 Traditional House

24 hour cycle at spring equinox

24 hour cycle at summer equinox

Appendix 8

Case studies: Temperature and Light logged March 21 - June 21, 2023



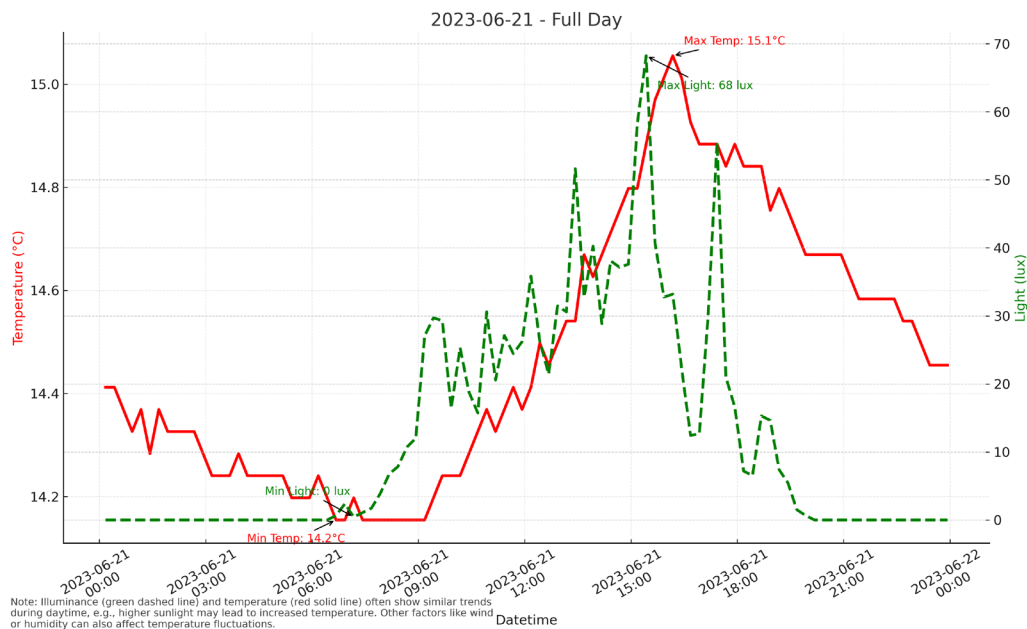
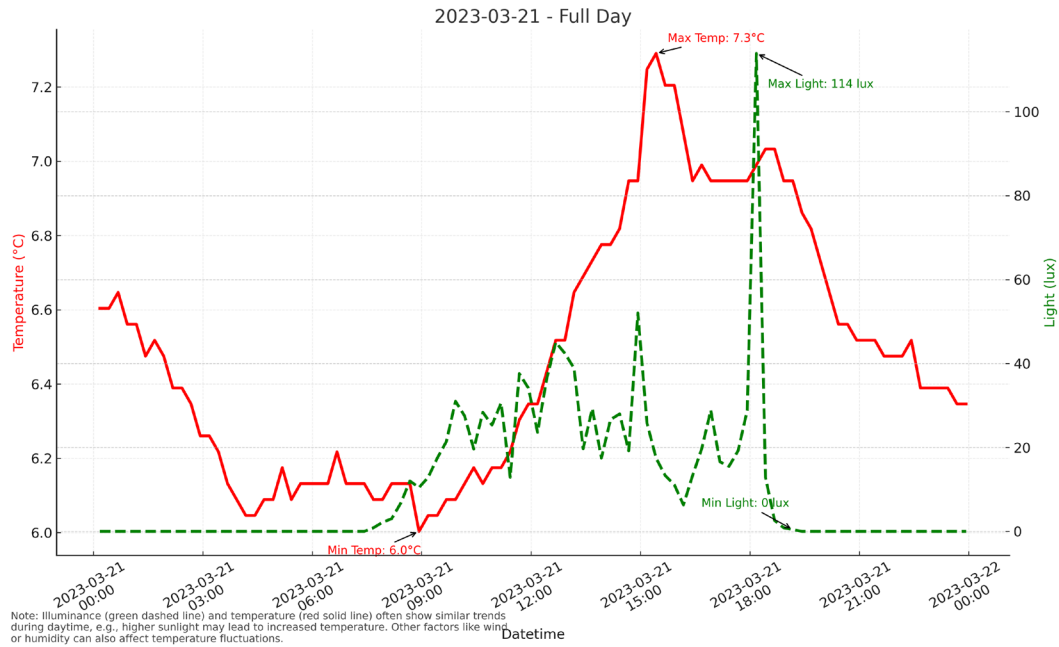
8.2 Facade House

24 hour cycle at spring equinox

24 hour cycle at summer equinox

Appendix 8

Case studies: Temperature and Light logged March 21 - June 21, 2023



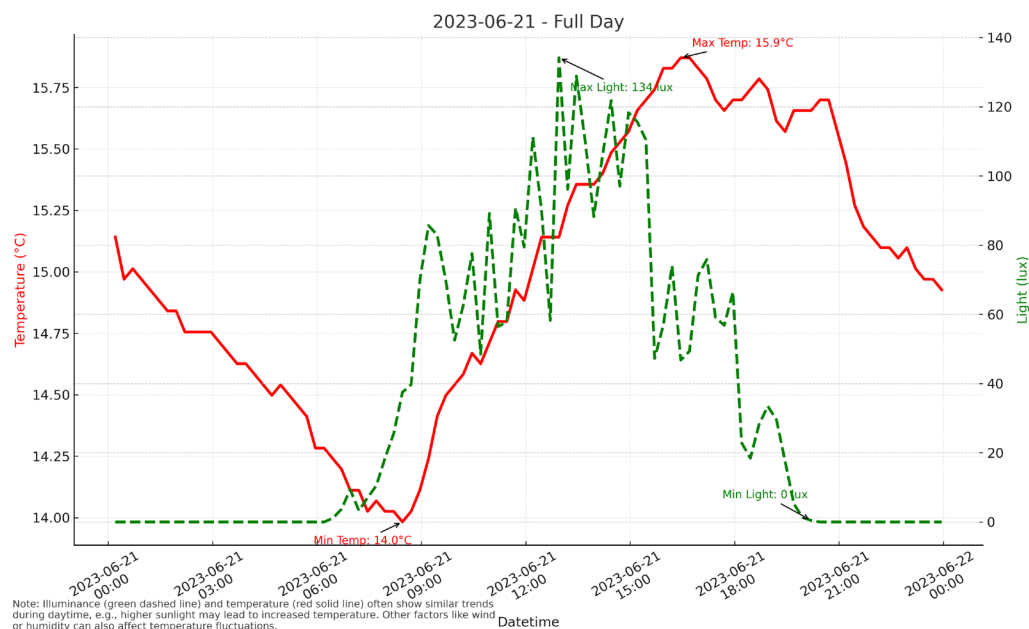
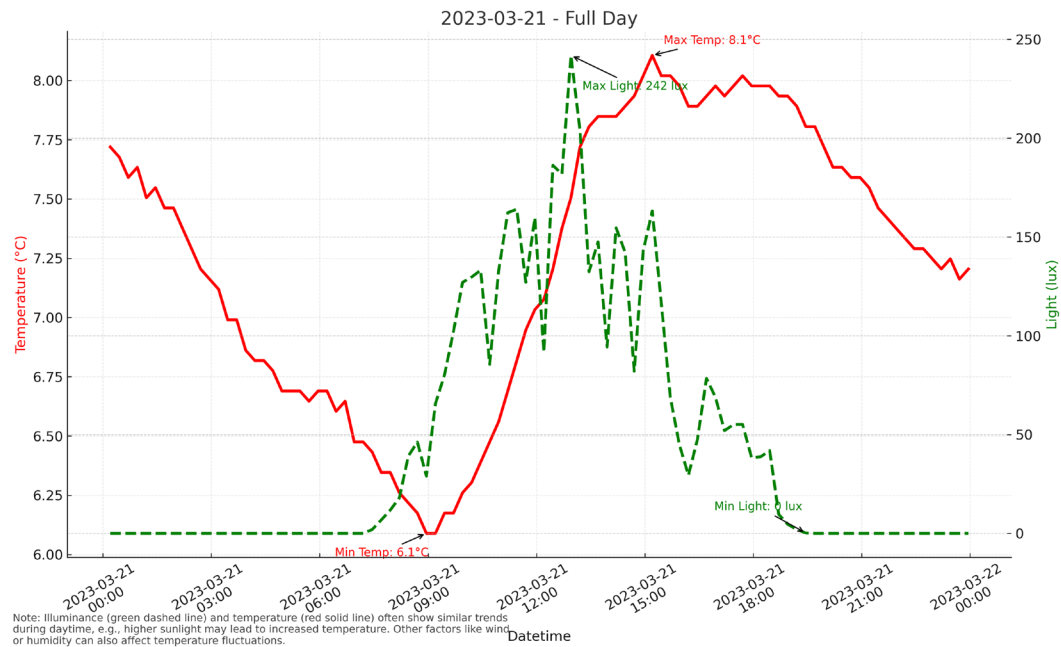
8.3 Double House

24 hour cycle at spring equinox

24 hour cycle at summer equinox

Appendix 8

Case studies: Temperature and Light logged March 21 - June 21, 2023



8.4 Rowhouse

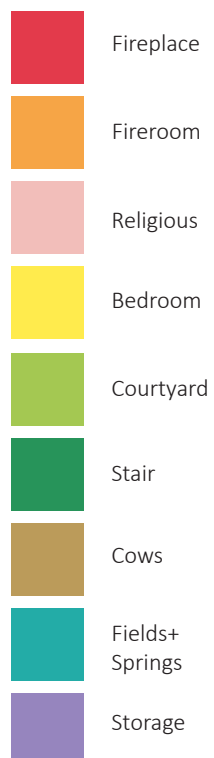
24 hour cycle at spring equinox

24 hour cycle at summer equinox

Appendix 9

Case studies: Programmatic analysis

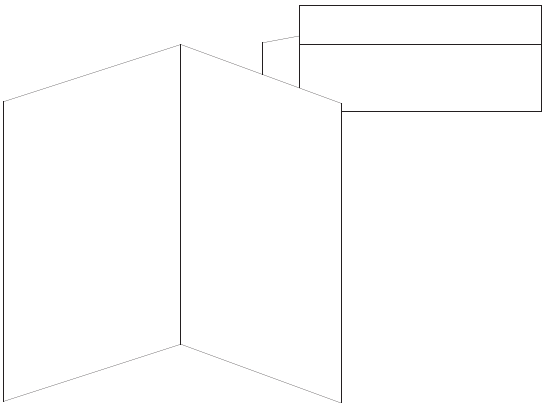
9.1 The Traditional House



Appendix 9

Case studies: Programmatic analysis

9.2 The Facade House



- Fireplace
- Fireroom
- Religious
- Bedroom
- Courtyard
- Stair
- Cows
- Fields+ Springs
- Storage



Appendix 9

Case studies: Programmatic analysis

9.3 The Double House

- Fireplace
- Fireroom
- Religious
- Bedroom
- Courtyard
- Stair
- Cows
- Fields+ Springs
- Storage

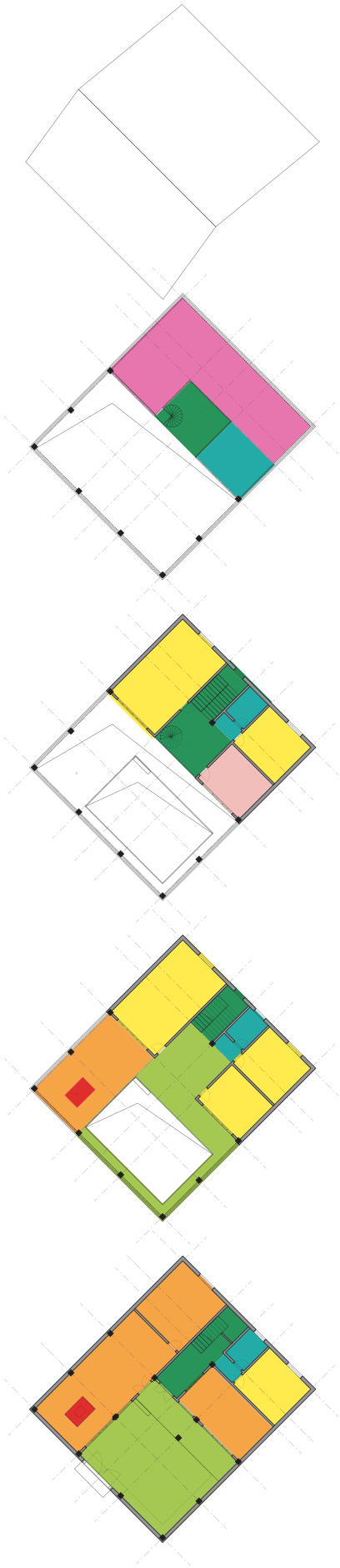


Appendix 9

Case studies: Programmatic analysis

9.4 The Rowhouse

- Fireplace
- Fireroom
- Religious
- Bedroom
- Courtyard
- Stair
- Cows
- Fields+ Springs
- Storage

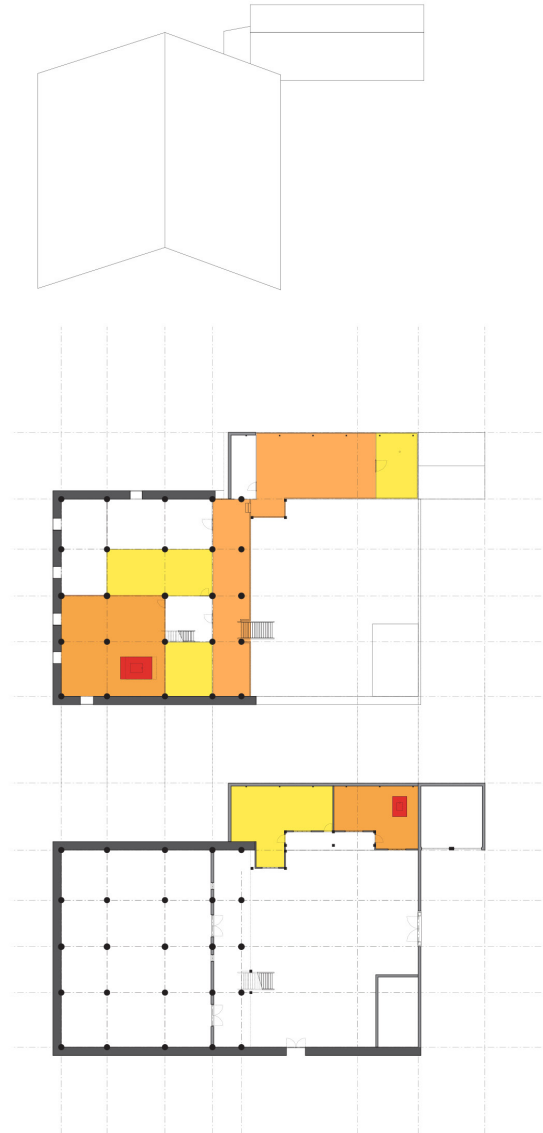


Appendix 10

Case studies: Comparing heat sources and bedrooms

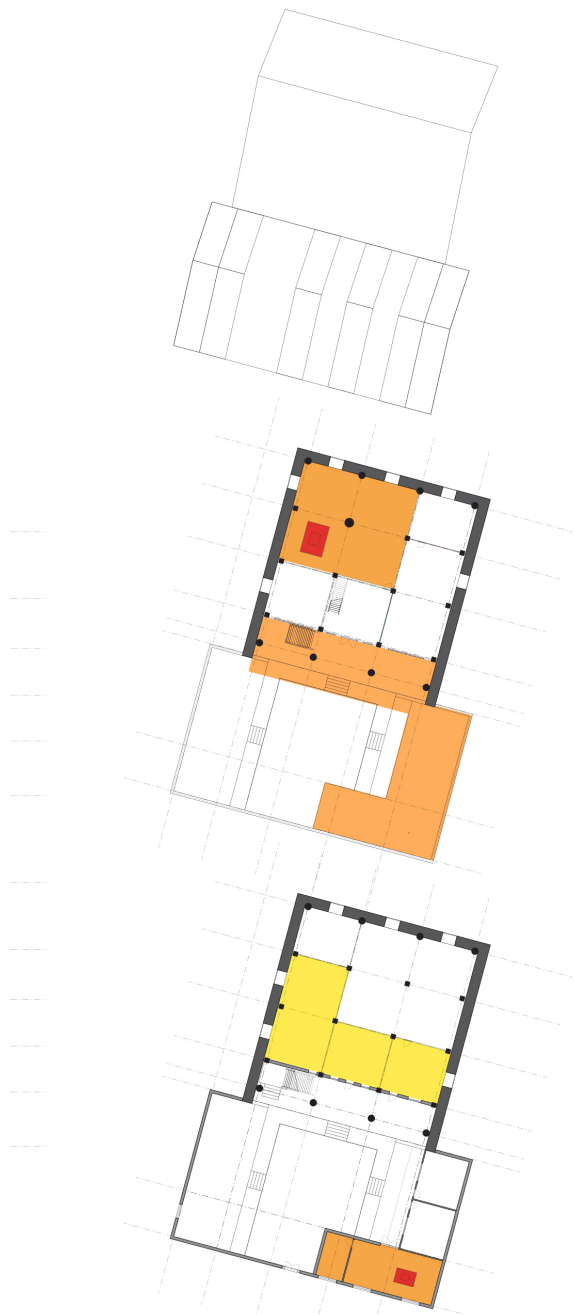


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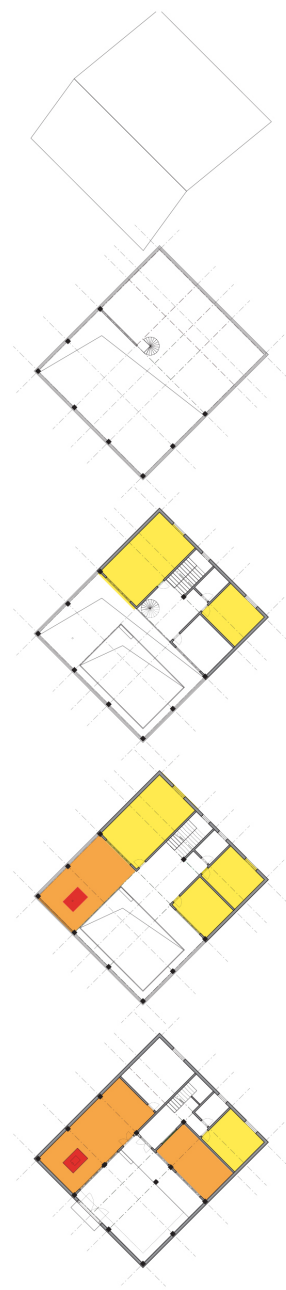


10.2

Appendix 10
Case studies: Comparing heat sources and bedrooms



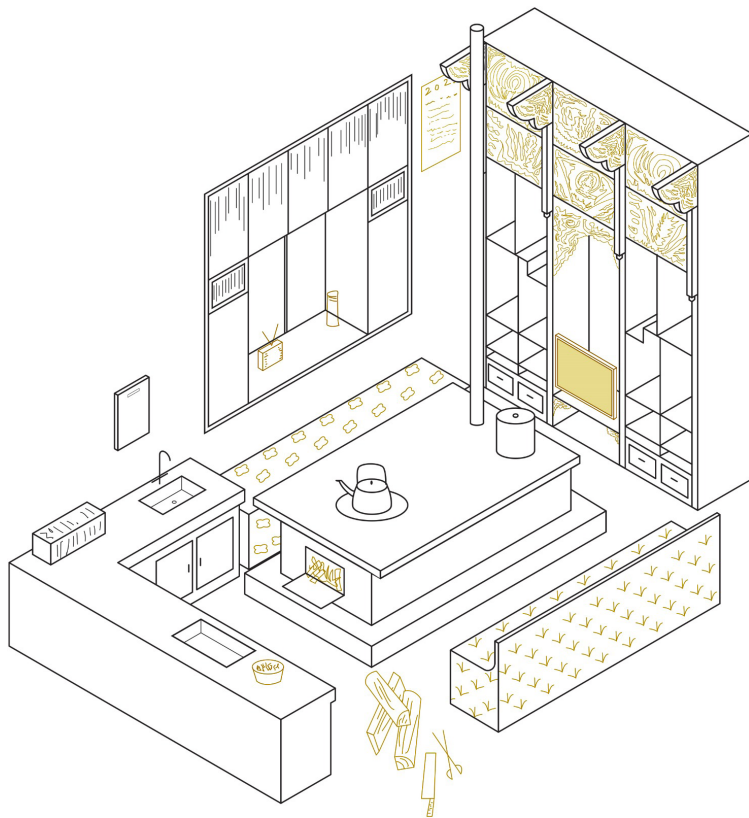
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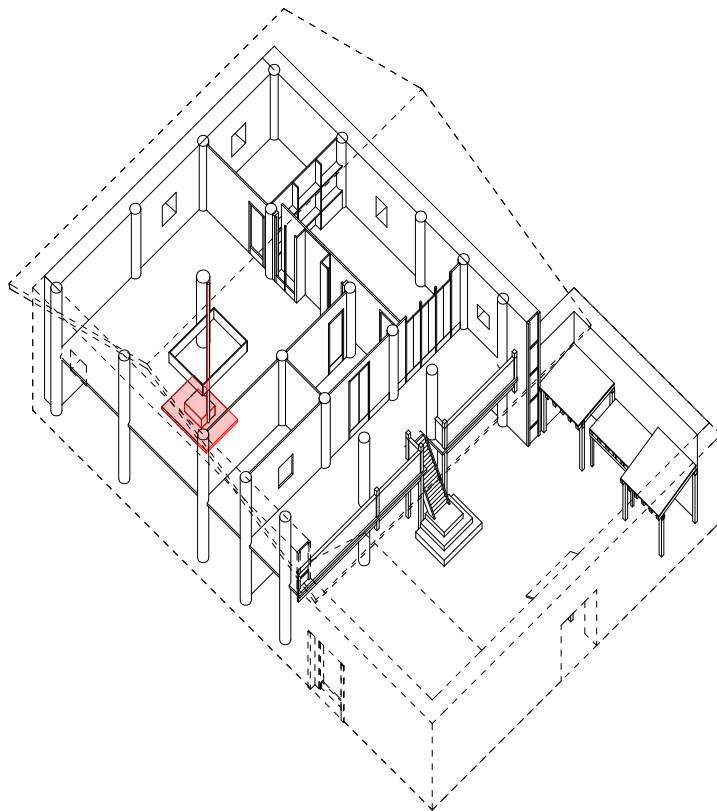
10.4

Appendix 11

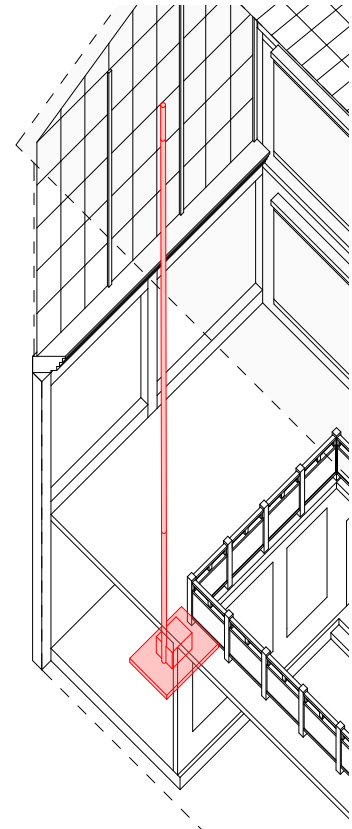
Cultural Artifacts: Fire Room adaptations



11.1

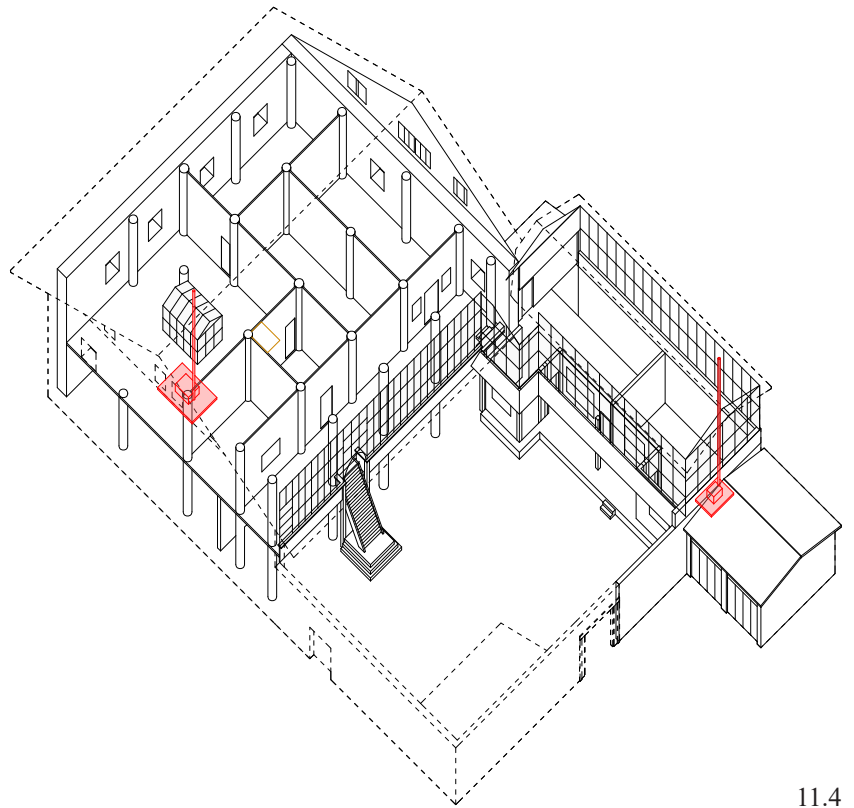


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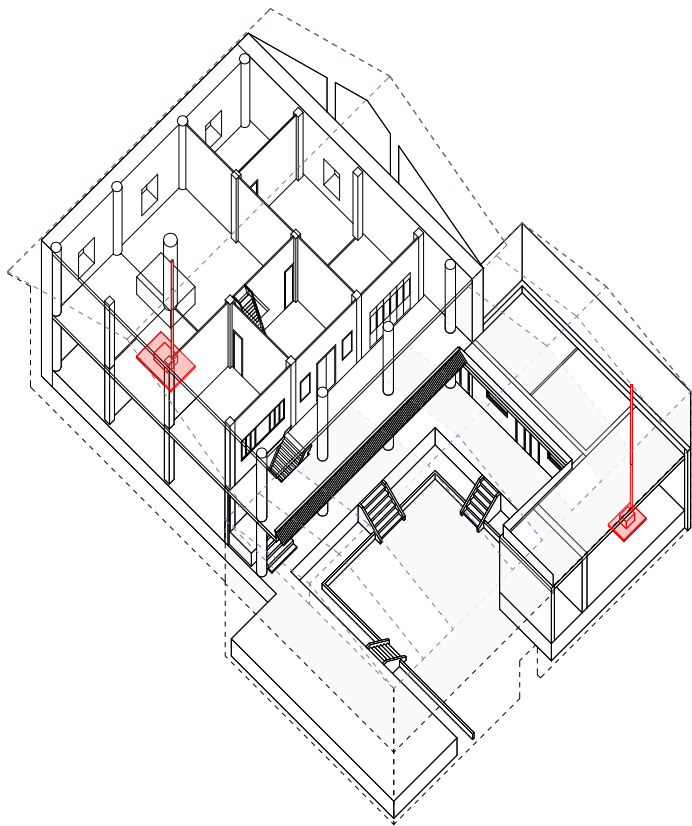


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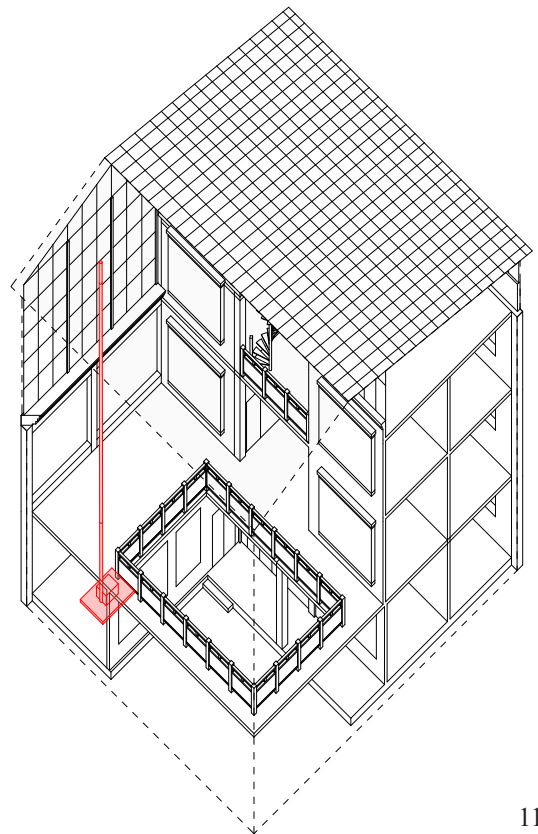
Appendix 11
Cultural Artifacts: Fire Room adaptations



11.4



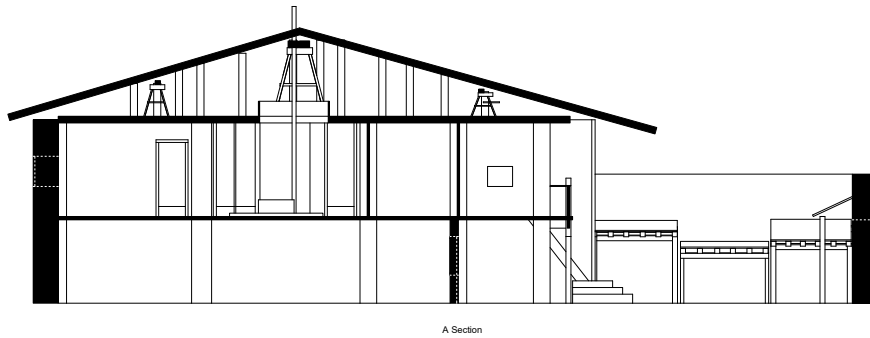
11.5



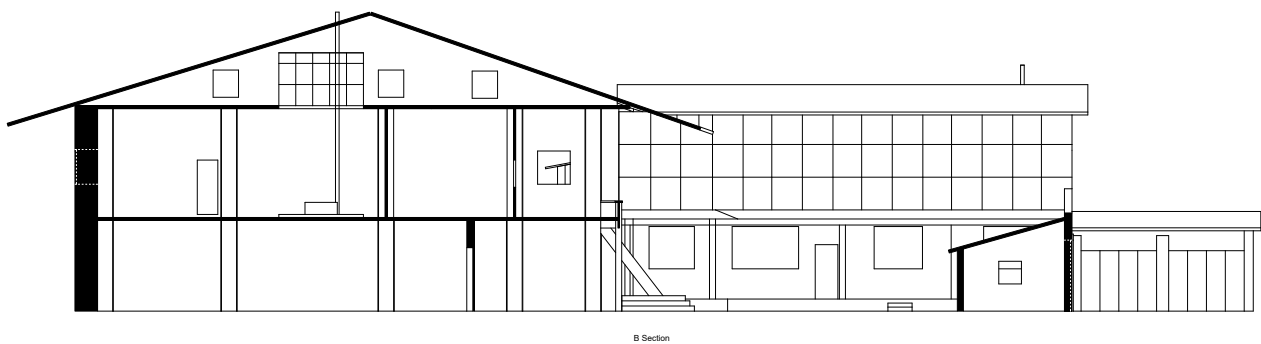
11.6

Appendix 12

Case studies: Permeable Thresholds



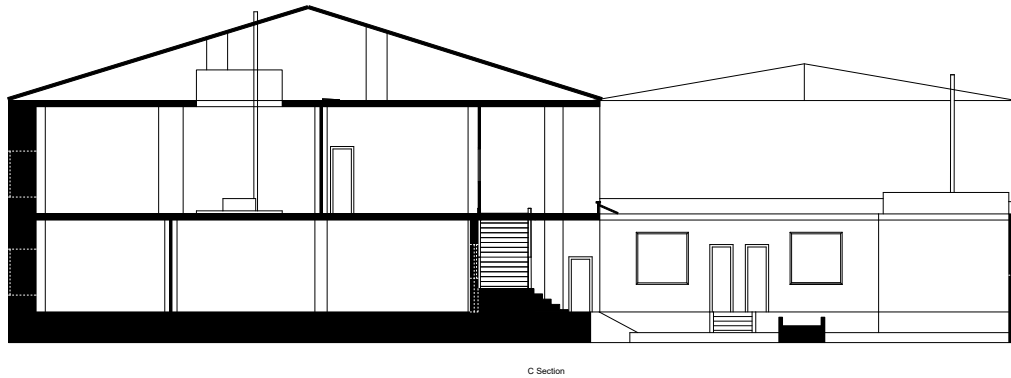
12.1 The Traditional House



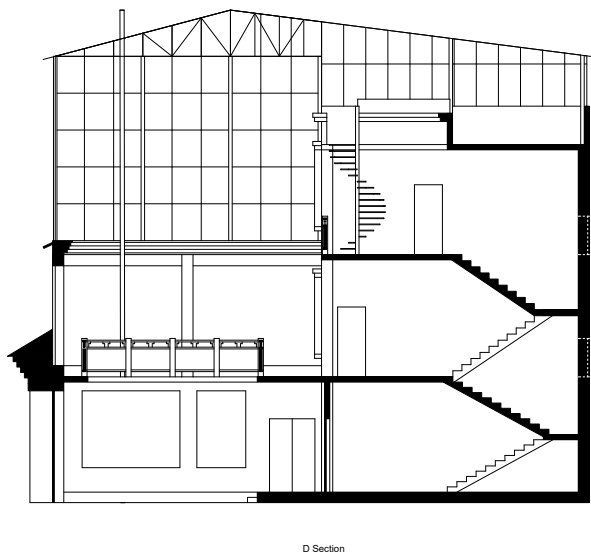
12.2 The Facade House

Appendix 12

Case studies: Permeable Thresholds

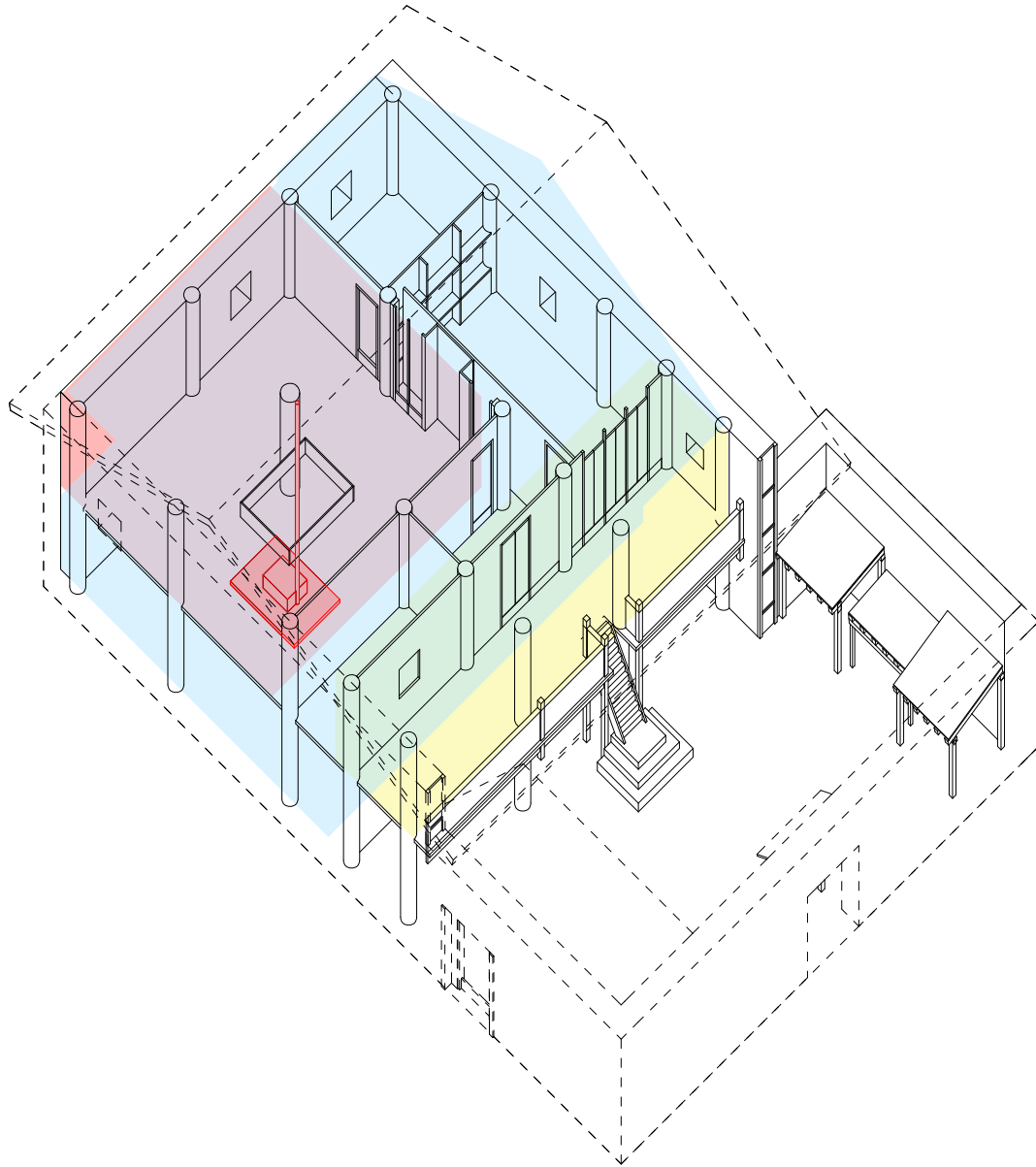


12.3 The Double House



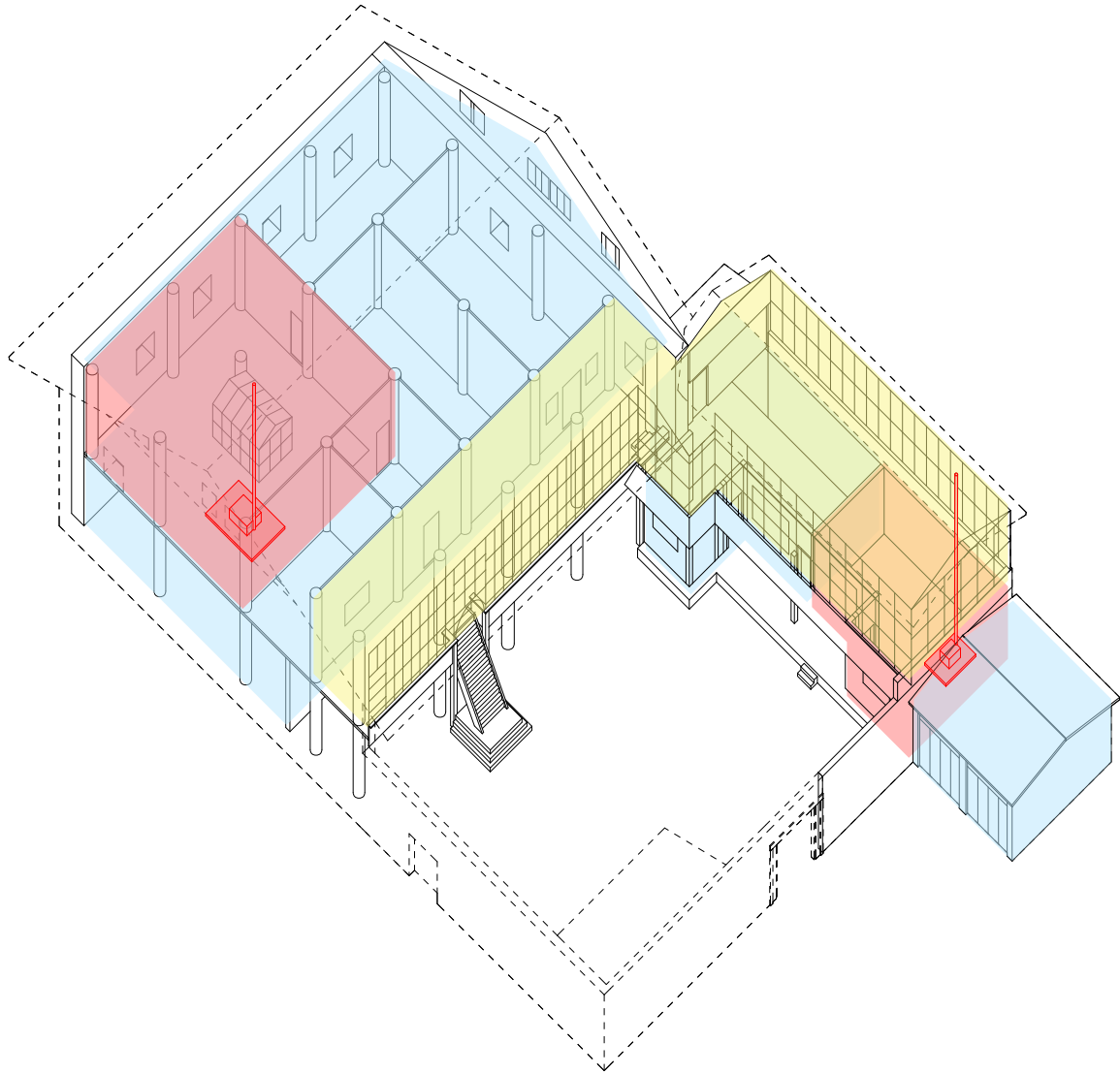
12.4 The Rowhouse

Appendix 13
Case studies: Compared Comfort Zones



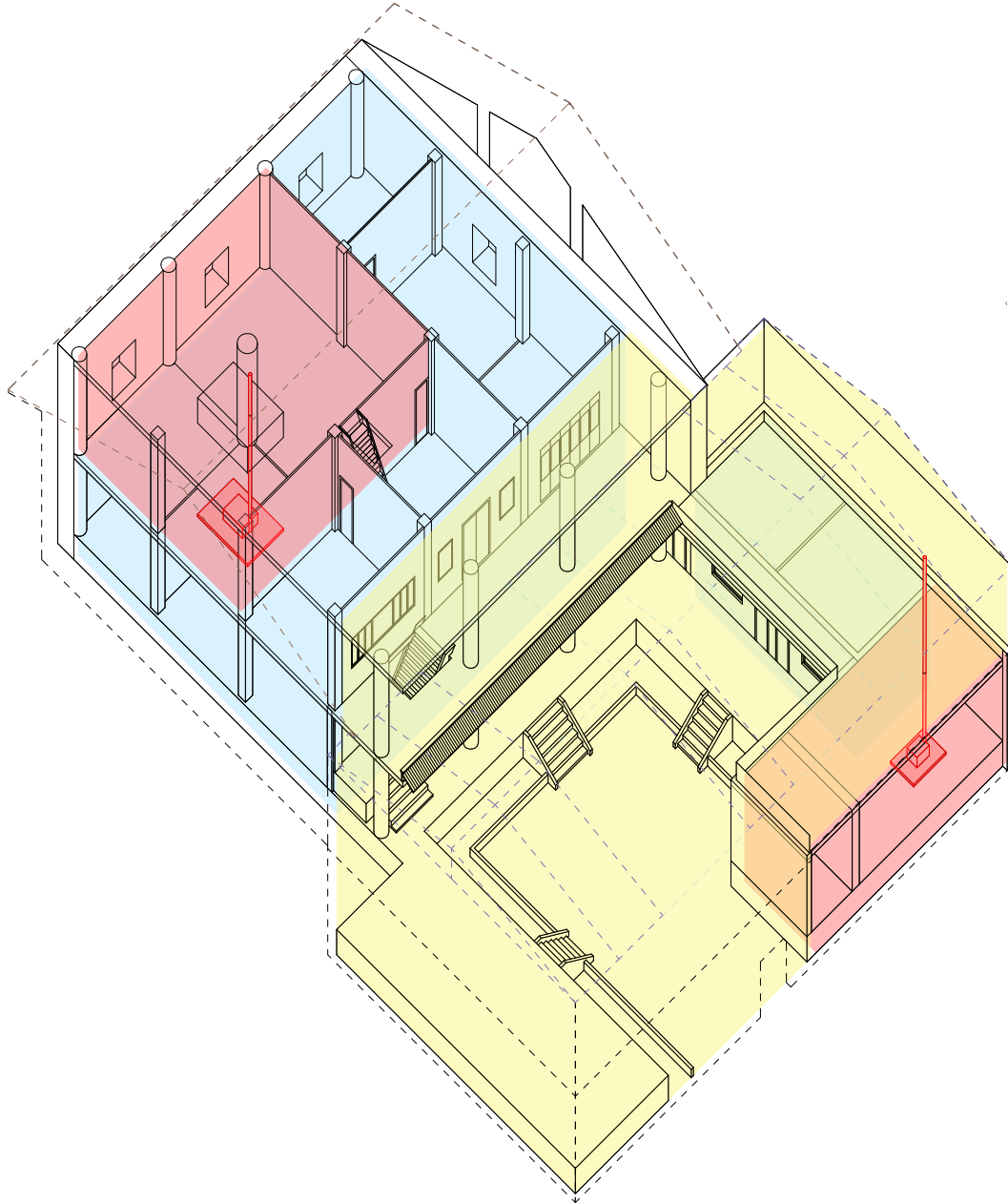
13.1 The Traditional House

Appendix 13
Case studies: Compared Comfort Zones



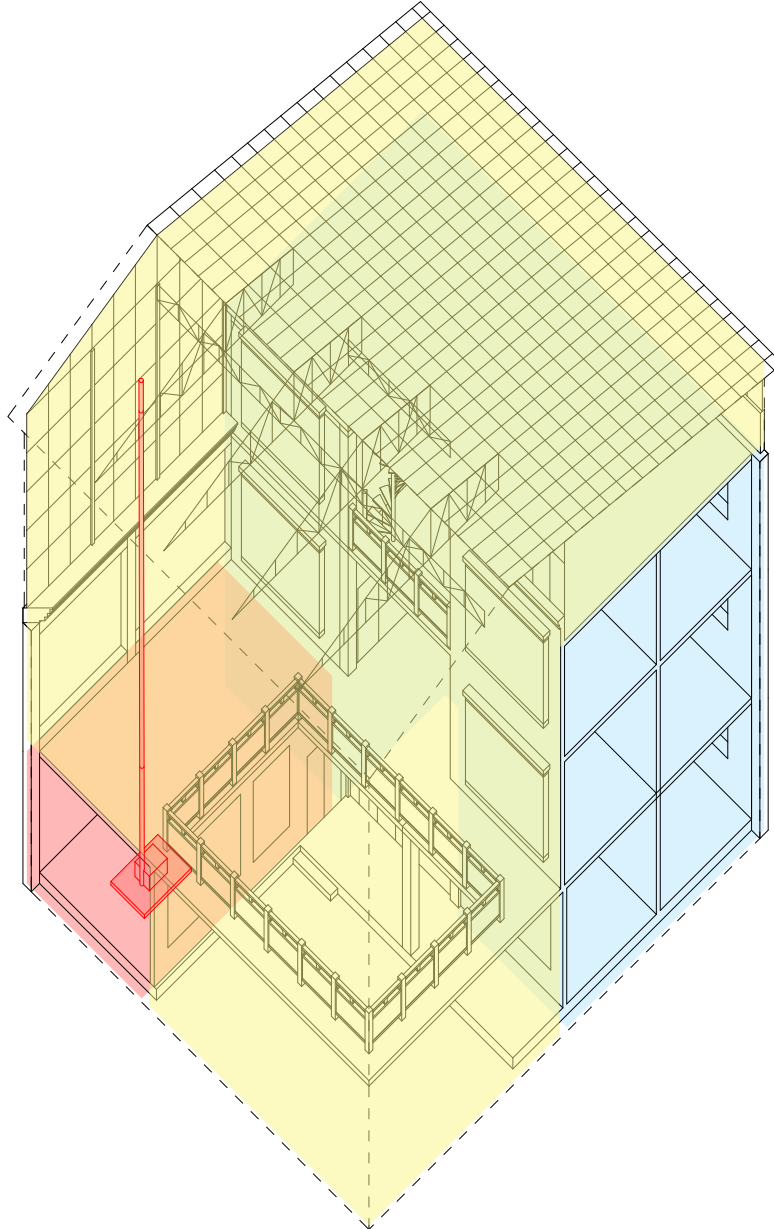
13.2 The Facade House

Appendix 13
Case studies: Compared Comfort Zones



13.3 The Double House

Appendix 13
Case studies: Compared Comfort Zones



13.4 The Row House